DECEMBER, 1938

Engineering and Mining Journal

A McGRAW-HILL PUBLICATION

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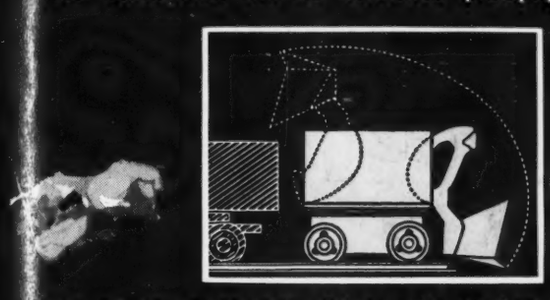
No Gadgets on EIMCO-FINLAY LOADERS

The world-wide success of the Eimco-Finlay Loader has, naturally, brought other mechanical mucking machines into the field . . . all of which resemble it as closely as possible in appearance. When contemplating the purchase of a mucking machine, however, there are three important considerations to keep in mind.

FIRST: The distinctive patented design and construction of the Eimco-Finlay Loader eliminates all necessity for auxiliary air cylinders, cut-off and kick-back devices, or other trouble-making "gadgets" of any kind.

SECOND: The only reason for having these "gadgets" on other loaders is to achieve a comparable operating cycle without violating our patent rights.

THIRD: Because the Eimco-Finlay Loader has no "gadgets", both air consumption and maintenance expense are very much lower than for any other type of mechanical mucking machine yet developed. Facts and figures to verify these statements will be furnished promptly on request.



Eimco patents give exclusive rights to the use of any rocker-arm profile other than a segment of a true circle, and thereby give exclusive rights to the many advantages derived from controlling the operation of a loader bucket in this manner. No other known method permits such simple, sturdy construction or gives such high efficiency.

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Salt Lake City, Utah, U. S. A.

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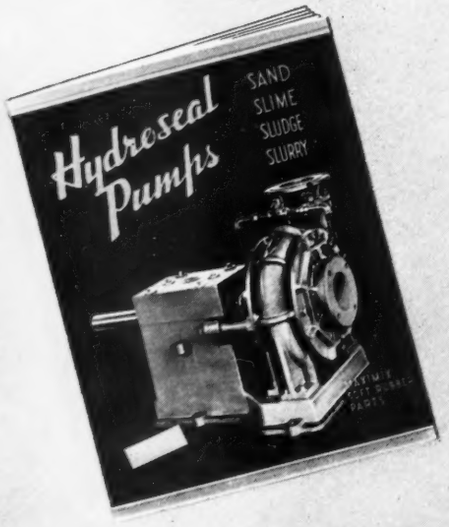

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Volume 139 Number 12

DECEMBER 1938

Canadian Trade Treaty Puzzles Zinc Producers

NOVEMBER 18 was a day of surprise and bewilderment for domestic zinc producers, for that was the date on which the State Department released the astonishing terms of the new trade agreement with Canada. The duty on zinc metal was reduced from 1.75¢. to 1.40¢. per pound. On ore the reduction was from 1.50¢. to 1.20¢. per pound of zinc content. Taken completely unawares by this action, producers pondered the probable consequences. They had not long to wait. On November 21 the St. Louis price for Prime Western zinc dropped from 5.05¢. to 4.75¢. per pound, and on November 29 another reduction was made to 4.50¢., prices corresponding to the level at which foreign zinc was offered in the domestic market. All told, the reductions amount to $11 per ton, a tidy sum in these days of high costs and unemployment in an industry that will market nearly 400,000 tons of metal this year.

The most charitable view of the State Department's action is that its experts were pitifully unfamiliar with the zinc industry, either domestic or foreign. But even so feeble a defense is inexcusable and inadequate because full information was at hand. If the industry's trade associations were regarded as biased and prejudiced informants, the Bureau of Mines was available as a competent and impartial adviser. The most casual inquiry would have elicited facts in defense of the existing duties.

Emphasis on the State Department's unfamiliarity with the business is increased by its action reducing by 50 per cent the duty on cadmium, a byproduct of zinc production. With a rare gift for mis-statement the Department defends its course by stating that "This metal is a byproduct of the copper refining industry and constitutes only a very small fraction of the value of that industry's products." Small, indeed, for the copper industry, but a considerable item for the zinc producer.

Nor does the published explanation of the reduction of the zinc tariff command confidence in the Department's knowledge of an industry that is in distress the world around. Vague reference is made to imports of zinc to supplement domestic production, with the inference that under normal conditions the latter is not able to meet consumption demand. The comment on fluctuations in the price of zinc also suggests that here, as in the case of imports, the Department placed too much reliance in mere statistics without interpretation. Apologetically it concludes that "The rates fixed in the agreement will leave substantial protection for the domestic producers of this commodity." On the contrary, the immediate effect has been to reduce prices, open the market to cheap imported zinc, increase unemployment at home, and demoralize a great industry that was gradually climbing out of depression. The full extent of the damage cannot yet be appraised, but it appears that serious injury has been inflicted on Tri-State producers and the entire Prime Western division of the industry.

Meeting the Wage-Hour Law

ALTHOUGH it is too early to appraise accurately the effect of the Federal wage-hour law on the metal-mining industry, a quick survey of the field indicates the trend of reaction. Compliance is general throughout the industry, even though some companies may consider themselves exempt on the ground of wholly intrastate operation. Wage rates have not been affected, because the industry now has far higher rates than the minimum required by law. But it has been necessary to adjust hours, and this has entailed lower weekly wages for some miners. Varied plans have been adopted by management to meet the hour requirements of the law. These are summarized on a news page in this issue.

Like the N.R.A. of unhappy memory and many other sweeping New Deal measures of good intent, application of the Federal wage-hour law immediately discloses the complexity of American business and the impossibility of drafting regulations that will be uniformly satisfactory for all industries. Mining has its peculiar characteristics, out of which wage-hour policies have developed that are fair and far from oppressive. The eight-hour day has long been standard practice, and the custom of basing wages on the price of metal has gained wide adoption. Wage rates and average weekly wages are higher than in manufacturing industries. As for the five-day week, without deprecating the benefit of added leisure, the fact remains that in many isolated mining operations, at least, a day's work and its income would be preferred above a day of idleness and expense. In short, it is quite possible that miners would rather determine their own working conditions through negotiation with employers than accept the questionable benefits of a plan imposed by law.

Whether the new law will increase employment throughout the mining industry is still a moot question. In some cases it has, particularly where the change has been made to a 40-hour five-day week, or where operations are continuous for 24 hours a day and seven days a week. But the miner's weekly income will probably be less, or at best remain the same. Undoubtedly mechanization will be increased wherever it can be adopted to reduce costs, and this will have some effect on employment.

In summary it may be said that early reaction to the new law by both employer and employee is unfavorable, with the ultimate effect on employment and individual income somewhat problematical.

Public Policies of a Great Mining Company

MENTION the subject of public relations in almost any group of intelligent industrialists these days, and you get a response of which the following is typical: It is the most vital problem in the nation today. What a company does, how it does it, and how it acquaints the public with its policies and performance have become matters of more than academic interest to people in all walks of life. The way in which a company conducts its business, its sensitiveness to the public welfare, its responsiveness to the interests of employees, customers, stockholders, and the communities in which it operates, have become quite as important as its products or its financial statement. Whether it stands high or low in public esteem depends on the spirit behind its business policies.

Among mining companies none has shown a keener appreciation of these things, nor a more substantial record of achievement, than International Nickel Company. For which reason we publish in this issue a brief outline of its public relations program. Physically international in the mining, refining, fabrication, and distribution of its major product and byproducts, "Inco" has had to meet the test of good public and industrial relations in several countries and in a great variety of consuming industries that comprise its customers. How well it has accomplished its aims, the reader may judge for himself.

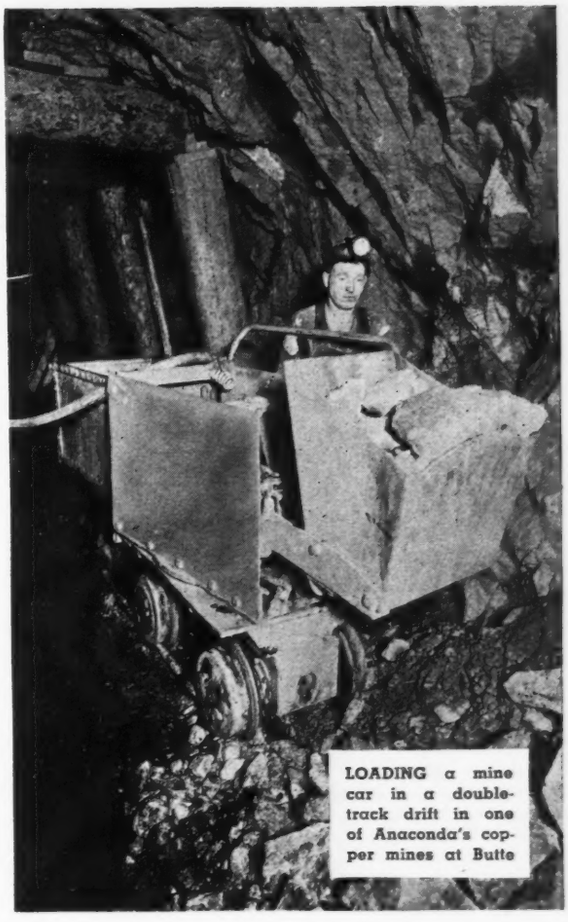
In our opinion the record is one in which the entire mining industry may take pride, because it refutes the criticism that has been leveled at "big business" for failure to recognize and discharge its obligations to the public. Not that the mining industry as a whole is above criticism, nor that small units are without similar obligations, but that evidence does exist that mining is sensitive to all that is involved in the words "public relations."

N. B.—Good public relations don't develop overnight. They cannot be bought in a package ready for use, nor do they thrive without the personal interest and attention of a high executive—in "Inco's" case, president Robert C. Stanley. His reports to shareholders and his annual reviews of the nickel industry give evidence of constant attention for many years to the public and industrial policies of his company. Evidently persistence is an essential quality, not only to establish but also to sustain a company's name and reputation.

Mechanical Loading In the Butte Mines

Anaconda has 75 mucking machines of various types in service

H. M. Courtney
Engineering Research Department
Anaconda Copper Mining Company
Butte, Mont.



LOADING a mine car in a double-track drift in one of Anaconda's copper mines at Butte

DURING the past five years, mechanical loaders have almost entirely replaced scraper-slides for loading mine cars in the mines at Butte, Mont. These loaders were found especially adaptable for use where, on account of their small size and portability, one loader unit may be used to service several headings. They are also well adapted for those places where the width of ore varies so that frequently the drift must be curved to follow the ore.

As deeper levels were opened, higher temperatures were encountered, which resulted in lowered efficiency and in high labor turnover in the workings where hand shoveling was in effect. Several of the early types of mechanical loaders had been tried with indifferent success, and it was not until 1928 that a satisfactory portable scraper slide was developed for loading mine cars. These slides, though a distinct improvement over hand loading in the larger drifts, were not entirely suitable for those of smaller cross-section. The units were generally not portable enough to be used in more than one heading. Hand mucking was still required in cleaning up the drift, especially in timbered drifts where the scraper would leave muck piled between the posts. Mucking around curves was difficult, sometimes requiring double handling of the muck. In large double-track drifts a cycle of drilling and mucking in alternate halves of the drift was worked out. This permitted mucking and drilling at the same time. One of the few advantages of the scraper slide over the mechanical loader is that the face can be mucked back and drilling started when car service is interrupted.

The mechanical loaders now in use in the mines at Butte are manufactured by several different companies and utilize practically the same loading principle—namely, the crowding and loading of the bucket with the propelling motor, and the loading and dumping of the bucket with a separate bucket motor. In loading the bucket, both power units are used together in crowding and lifting the bucket from position *A* to position *B* in Fig. 1 (page 32). The power units are identical reversible air motors and controls for each are located close together on the side plate of the loader. In operating the loader the operator works from a removable platform, on which he stands and can swing the bucket to either side, operate the controls, and release the car to which the loader is coupled. The propelling motor is mounted on the under-carriage between the axles, to which it is directly coupled, and, being reversible, it can crowd the bucket into the muckpile or it can be used as a tramming unit within the limits of the air-hose connection. A convenient clutch located between the gear reduction of the motor and the axle drive allows for propelling the loader by hand as when pushing it on and off the cage, or moving it to and from a heading with the electric storage-battery locomotive.

From Fig. 1 the manner of loading and dumping the bucket may readily be understood. The bucket motor drives a winding reel which pulls the chain attached to the rocker arms. The bucket is crowded into the muckpile (position *A*) by the propelling motor. At the same time, the upper motor lifts the bucket until loaded (position *B*). This is repeated until the bucket is filled. Usually one pass is sufficient. The dumping position of the bucket is shown by position *D*. For transporting on cages the bucket is placed in position *C*.

The rocker arms or bucket arms roll on a track just inside the side plates and the bucket motor is mounted in the clear between these tracks. The whole top section is connected to the under-carriage with a king pin and can be rotated from side to side. With this arrangement it is possible to dig 2½ ft. outside the edge of either rail. A centering device automatically brings the bucket to dumping position over the car. Two springs on the cross-

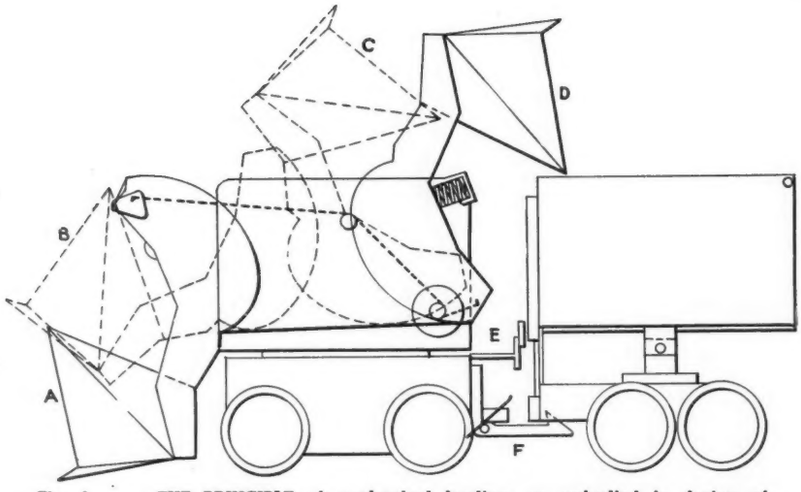


Fig. 1 . . . THE PRINCIPLE of mechanical loading, as embodied in design of mucking machines used at Butte. *A*, Bucket at start of crowd. *B*, Bucket loaded, end of crowd. *C*, Bucket position when caging loader. *D*, Bucket in dumping position. *E*, Car bumper on loader. *F*, Car coupler

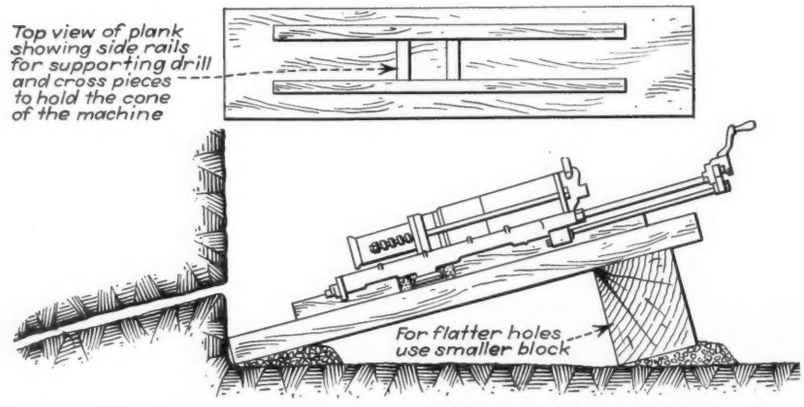

Top view of plank showing side rails for supporting drill and cross pieces to hold the cone of the machine
For flatter holes use smaller block

Fig. 2 . . . THE "LITTLE FINN" used to facilitate the drilling of lifters in the Butte mines. To lower the starting point of the hole, the device is moved back and longer steel is used

member between the side plates absorb the shock of dumping.

Improvements in design and construction of such mine-car loaders are being brought about not only by competition among the various manufacturers but by the constructive criticism offered by the loaders' users. There are five manufacturers supplying this equipment at present, and many future improvements are anticipated.

The first machines of this type used in the Butte mines were two loaders designed and built by John Finlay, superintendent of the North Lily mine, in Utah. They were in use during 1932, 1933, and 1934 but were not substantial enough to stand up under the hard service to which all loaders are subjected.

Following this original design, the first factory-built machines that came to Butte were placed in service in 1933. They weigh about 3,200 lb. and are powered by two four-cylinder air motors. They have two wheel-drive chains, one driving each axle from a double sprocket on the propelling motor. The bucket is raised by one chain connecting the crosshead on the bucket arms and the winding reel, which is driven by bevel gears from the bucket motor. There is an idler roller on top of the bucket-motor gear housing. The rocker arms are of the curved type and are held in place on their racks by four cables, two on each rocker arm, and one end of each cable is connected to the arm and the other end to the rack. A spring-and-screw connection on one end of each cable permits adjustment of the cable tension. The upper deck and under-carriage are held together with a short bolt-type king pin. Steel balls are fitted in races milled in the under-carriage and underside of the top deck, allowing the top deck to turn freely. The bucket is automatically centered by a cable-type centralizer. A short cable attached to the under-carriage is connected by a linkage to the top deck, which swings the upper deck and bucket to the center by a lever actuated by the rocker arm cables when the bucket is raised. Controls for the air motors were originally four-way plug valves with piping to the top motors and two hoses to the bottom motor, allowing rotation of the top deck. In Butte, these plug valves have been replaced by plate valves, which have been found more satisfactory.

Later improvements were made on this model, resulting in the introduction of a loader which was first used in the Butte mines late in 1937. This machine weighs about 3,900 lb. and embodies the following improvements: It has gear-driven axles and the turntable ball races are of the insert type and are renewable. The centralizer is of a drum type. A roller pin on the under-carriage engages a cut-out drum mounted on the top deck and is rotated by an arm-type linkage attached to one rocker arm.

A loader made by another manufacturer is powered with two five-cylinder piston-type air motors and the total weight of the machine is about 4,200 lb. It was introduced in the mines in Butte early in 1936. Its design embodies gear-driven axles, toothed dipper arms and racks, and dipper-arm rollers and guides on the side plates. Two bucket chains and the winding reels on a jackshaft are driven by the top motor through a sprocket chain. A long, vertical, tapered king pin on the under-carriage, on which two Timken roller bearings are mounted, connects the under-carriage to the king-pin bearing housing on the deck. A roller-type centralizer is attached to a cross-member between the dipper arms and guides the bucket to a central dumping position. This roller guide is similar in shape to a "wishbone" and is attached to the top of the tapered king pin, which does not rotate with the top deck. By removing the roller the bucket can be dumped off center, should the need occur while mucking on a curved track. An automatic shut-off stops the air to the top motor as it approaches the dumping position, which lessens the shock on the dipper chains and arms. Control valves are located on each motor, the bottom motor valve control being operated by a flexible cable from the operator's side plate lever, and the top motor valve is operated by a shaft lever and linkage.

A loader manufactured by a third company was put in service in May, 1938. It weighs approximately 4,600 lb. and is powered by two four-cylinder piston-type air motors. This machine has gear-driven axles, circular rocker arms and cables, two bucket chains and a winding reel jackshaft, and a vertical-type king pin. A novel centering device is used and consists of two air cylinders operated by a control button on the bucket operating lever, which centralizes the bucket upon release of the button. This helps the operator in swinging the bucket to a new position while loading and permits the machine to be centered with the bucket in any position. It also allows the bucket to be dumped off-center should the need occur while

mucking on curved track. At present the Anaconda Copper Mining Company has 75 mechanical loaders of various types at its Butte properties. In Table I is shown the total cubic feet of excavation handled by these loaders, the percentage of all sill excavation loaded, and the number of loaders on hand at the end of each period listed. This table shows a very satisfactory increase in the use of mechanical loaders.

Table I—Mechanical Loaders in Butte Mines

Year	No. of Loaders	Cu. Ft. Loaded	% of All Sills
1933.....	2	67,026	2.3
1934.....	3	46,626	2.1
1935.....	8	327,308	4.8
1936.....	25	1,734,132	15.0
1937.....	52	4,097,576	25.3
1938 (6 mo.).	54	2,705,448	49.8

Note: "Cubic Feet Loaded" is calculated from ground in place and for a tonnage comparison. Ten cubic feet are equivalent to one ton.

Underground mining is generally carried on two 8-hour shifts per day at Butte, one shift starting at 8 a.m. and one at 6 p.m. All mining is done on a contract system, unit prices being set for breaking ground, for timbering, and for mucking. The prices vary, depending on the location or working conditions, and most prices are on a cubic-foot (in place) basis, although a number of drifts are driven on the basis of a unit price per linear foot. The number of men working per shift on one contract depends on the size or number of headings being worked under that contract. Two men per shift, however, is the most common practice. When a large double-track heading is worked, or more than two small headings are worked together, three or more men may be used to advantage on each shift. The drilling and mucking cycle of operations in a drift or crosscut may depend on coordinating other mining operations on the level to permit uninterrupted delivery of empty mine cars to the loader.

The Operating Cycle—The minimum cross-section of a drift in which a loader can work effectively is 7 ft. high by 5 ft. wide. The standard cross-section for most laterals and crosscuts is 8 or 9 ft. high and 6 or 7 ft. wide for untimbered drifts and 10 or 11½ ft. high and 8 or 9 ft. wide, outside of timber, for timbered drifts. Drifts in ore are sometimes wide and irregular, due to following the ore. In all drifts and crosscuts either a long-round cycle or a short-round cycle may be used.

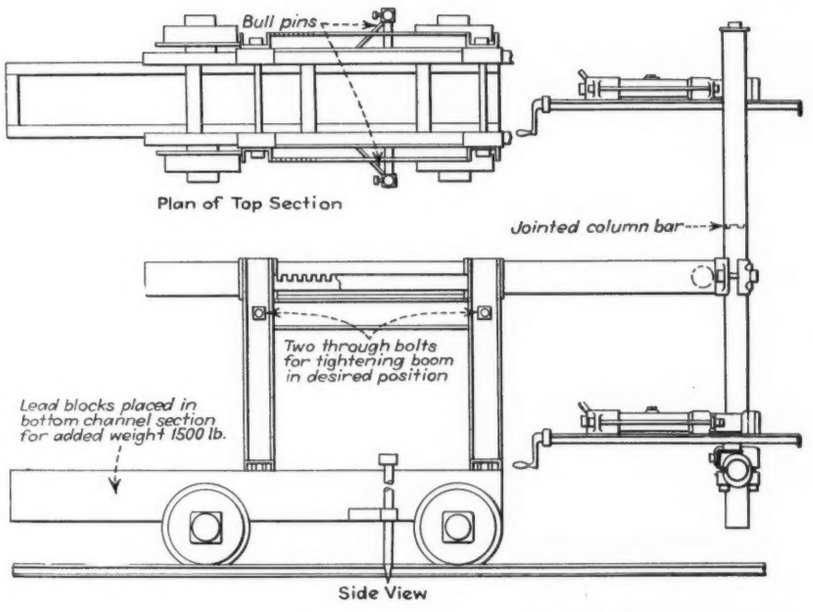
A long-round cycle in a heading is one in which the drilling is done by two men with two drills for an entire shift. Mucking and timbering are done on the following shift. This method is well adapted to timbered drifts of larger cross-section. Two headings can be driven on the same contract using three men per shift, two men drilling in one heading and one man operating the loader in the other heading. If three headings are available, it is possible to alternate headings and gain two or three extra rounds per week. In a 10x10-ft. timbered heading at one of the mines an average advance of 6 ft. was obtained with a 28-hole horizontal V-cut round. This round required a little over five hours of drillings, and the loading of the resulting 65 to 75 cars required 2½ to 3½ hours, the rest of the time being devoted to timbering and installing tracks. In an 8x6-ft. untimbered heading an average advance of 8½ ft. per round was obtained using a burn-cut round. This was in a single heading, drilling 17 or 18 9-ft. holes, then mucking on the following shift, and setting up the drilling equipment for the oncoming drilling shift.

A short-round cycle consists of a complete mucking and drilling operation in one heading in one shift. Depending on conditions, either of two methods is followed. A down-cut round is used in which the miners set up a horizontal crossbar over the muck pile. Either one man or two men operate one or two drills while the other runs the loader. On completion of the drilling on the crossbar, the breast is cleaned out with the loader, the lifters are drilled with a "little Finn," shown in Fig. 2, and the round is loaded and blasted. With this device the round is drilled with one set-up of the crossbar. Another method is to muck out the complete round, set up a vertical bar with two crossarms and two drills, and drill and blast the round with two men. Other conditions may require the use of two column bars. A lateral drift and one or two crosscuts are being driven at an average rate of over 100 ft. per six-day week. The drift is being worked three shifts per day with

CLEANING UP at the side of a track as the work of mucking out a heading progresses

CROWDING into muck pile. This is one of many loaders, of different types, in service underground in Butte

Fig. 3 . . . **PORTABLE CARRIAGE** for two drifter drills. This reduces total time required for setting up and tearing down by more than one hour, permitting drilling of deeper rounds


Bull pins
Plan of Top Section
Jointed column bar
Two through bolts for tightening boom in desired position
Lead blocks placed in bottom channel section for added weight 1500 lb.
Side View

three men on each shift, inasmuch as their duties include tramming to the station and carrying a drainage ditch. In cross-section this untimbered drift is 9x7 ft. An average round slightly over 6 ft. deep is broken every shift with a pyramid cut. At another mine a weekly advance of 40 ft. is obtained, loading 30-cu.ft. cars and working two men per shift and two shifts per day in a heading 8½x11 ft. in cross-section.

When three headings are worked, two can be mucked out every shift and two drilled every shift. At the beginning of each shift one heading is ready for drilling and the other two are ready for mucking. The loader crew cleans out one heading before lunch and one after, thus mucking out two complete rounds. The drilling crew drills the face available at the start of the shift first, and then moves to the first heading cleaned out by the loader. These two breasts are blasted going off shift, thus making the same set-up available for the coming shift.

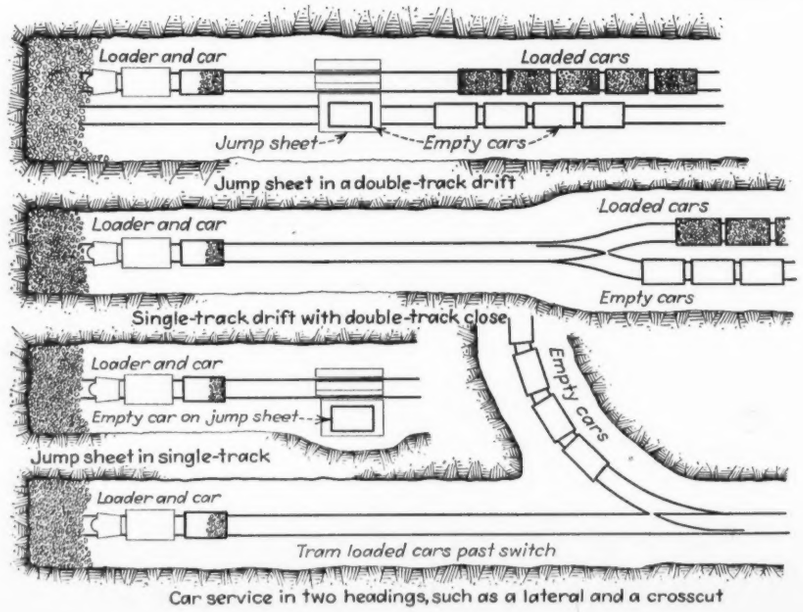
In wide occurrences of ore a small drift may be advanced on either the footwall or hanging-wall side and the drift enlarged to the full width of the ore, at which time the additional track required for the loader is advanced. When enlarging a drift, drilling and mucking can proceed at the same time. Another method is to advance the whole breast at the same time by alternately drilling a vertical V-cut round in one-half of the face and enlarging the rest of it in the same blast. By mucking first on the side with the least amount of muck, drilling may be started while cleaning out the remainder of the round from the other tracks. In one ore drift which was 12 ft. high and 16 to 22 ft. wide, the drilling required up to three complete shifts and the mucking and timbering more than two shifts. In this instance three rounds of about 6 ft. advance each were obtained per six-day week. A horizontal V-cut round is generally used in narrower drifts where room is not available for drilling the vertical V-cut, and also in ground that requires timbering to be carried close to the face. In these cases the round is mucked out, timber stood, and drilling begun. If necessary, stringers are advanced ahead to support the back while mucking.

From the foregoing it will be seen that a wide selection of cycles is possible and the purpose in adopting any particular one is to obtain the highest efficiency for that set of conditions.

Table II—Operations With Drill Carriage and Mechanical Loader for Week on One Contract

		Drilling Cycle					Mucking Cycle			
1938 Date	Shift	Work Place	No. of Men Drilling	Holes Drilled	Feet Drilled	Advance for Round	Work Place	No. of Men	Cars of Muck	Total Men
4/20	7 a.m.	3603	2	25	160	6	3604	1	34	3
Wed.	3 p.m.	3604	2	22	150	5½	3603	1	49	3
	11 p.m.	3603	2	25	165	6	3604	1	49	3
4/21	7 a.m.	3604	2	25	145	5	3603	1	41	3
Thur.	3 p.m.	3603	2	25	155	5½	3604	1	49	3
	11 p.m.	3604	2	27	164	4	3603	1	49	3
4/22	7 a.m.	3603	2	25	155	5½	3604	1	43	3
Fri.	3 p.m.	3604	2	22	148	5	3604	1	54	3
	11 p.m.	3603	2	26	169	5	3604	1	38	3
4/23	7 a.m.	3604	2	26	168	7	3603	1	42	3
Sat.	3 p.m.	3603	2	25	169	5½	3604	1	59	3
	11 p.m.	3604	2	25	165	5½	3603	1	45	3
4/25	7 a.m.	3603	2	26	176	6½	3604	1	47	3
Mon.	3 p.m.	3604	2	26	170	6	3603	1	45	3
	11 p.m.	3603	2	30	190	6	3604	1	53	3
4/26	7 a.m.	3604	2	25	165	5	3603	1	46	3
Tue.	3 p.m.	3603	2	29	186	5	3604	1	31	3
	11 p.m.	3604	2	24	160	6	3604	1	37	3
Totals		3603	18	236	1525	51	3603	9	409	26
		3604	18	222	1435	48	3604	9	403	28
Total (Both)		....	36	458	2960	100	....	18	758	54

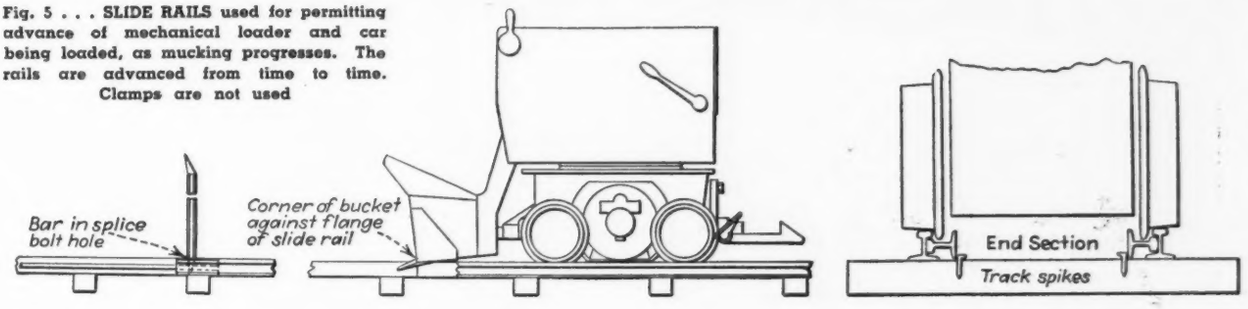
All rounds burn cut. Cross-section 3,603 is 9 x 7½; 3,604 is 9 x 7.



Car service in two headings, such as a lateral and a crosscut

Fig. 4 . . . **MINE CARS** must be supplied properly to an underground loader to insure maximum efficiency in operating cycle. Here several ways of doing it are illustrated

Fig. 5 . . . **SLIDE RAILS** used for permitting advance of mechanical loader and car being loaded, as mucking progresses. The rails are advanced from time to time. Clamps are not used



Drilling is materially speeded up by using a drill carriage, upon which two drifter drills are mounted. This reduces the total time required for setting up and tearing down by more than one hour, which time is utilized for drilling deeper rounds. A sketch of this drill carriage is shown in Fig. 3. Fifteen hundred pounds of lead blocks weighing 85 lb. each placed in the bottom channel of the drill carriage stabilizes it sufficiently to drill with both machines at the same time without blocking the vertical bar supporting the machines. The time required for setting up to drill is that necessary for moving into the heading, lining up the machines, connecting one air and one water hose, there being a manifold on the carriage, and driving in two bull pins, which are attached to the bottom channel on either side of the machine. No rail clamps are used. For moving around sharp curves and through low headings, the top machine and bar may be dropped on the platform and the boom moved back to shorten the over-all length. Table II gives a summary of each shift's operations and a weekly "recap" of the work of one of these drill carriages and the mechanical loader for one contract week.

Handling of mine cars, empty and loaded, for servicing a loader is illustrated in the three sketches shown in Fig. 4. The first sketch shows the use of a "jump" sheet as employed in a double-track drift. Empty cars are transferred to the loader track, using the "jump" sheet as a turnsheet to swing the car after the loaded car is trammed past this sheet. It is usual practice to place lagging of the proper thickness between the rails to assist tracking of the empty car on the loading track. The second sketch shows a single-track drift with a double-track section close behind, the empty cars being on one track and the loaded cars on the other. A jump sheet may be used close to the face by bringing up an empty car when the loader is loading another car and placing it on the jump sheet to allow the loaded car to pass. This is not often done, as it necessitates jumping the car off the track onto the jump sheet to allow passage of the loaded car. California-type switches may be used in long, single-track headings. These are portable double-track sections and switches which are slid or rolled on top of the permanent track.

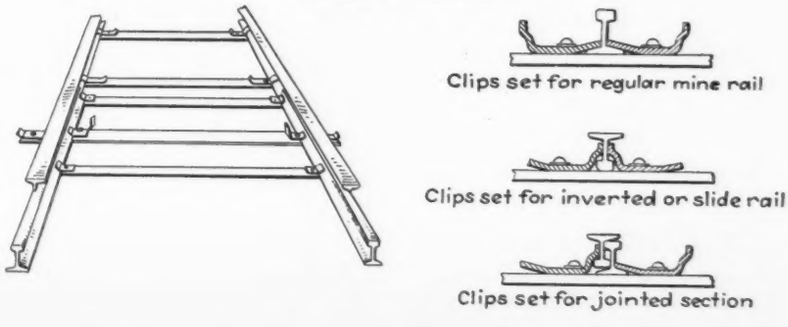
Fig. 4 also illustrates a lateral drift and crosscut which is worked the same as a single heading with a double-track section behind except that backswitching of empty cars is required. Double-latch, weight-type automatic switches are used to eliminate hand throwing of the switch, as the empty cars can run through the closed switch. Tramming time is subject to many variables and requires about half a minute with the jump sheet method under best conditions, and about 4 minutes for 52-cu.ft. cars under average conditions if the tramming distance is long. Some loader operators have a bucket ready to dump as soon as an empty car is coupled to the loader, and this decreases the over-all time of loading and tramming considerably.

Fig. 5 shows the use of slide rails and methods of advancing them. The rails are advanced from time to time into the muck pile, thus providing a footing for the loader and car. Rail clamps are not used. The slide rail is held in place by regular track spikes as shown in the sketch. For curved sections of drift, short slide rails are used, the permanent rail being installed when the drift is advanced beyond the curve. On straight track, 15-ft. lengths of mine rail are used for slide rails. The ties are placed as this temporary track is advanced. When the slide rails are extended, they are turned up and spiked into their permanent position, and a new set of rails is used for slide rails. By placing a pick point or pinch-bar point in the bolt hole in the web of the rail and using the loader for power, the slide rail may be advanced, or returned for realignment or for placing a permanent tie. Slide rails may usually be advanced by placing the edge of the bucket against the bottom flange of the slide rail and applying the traction power.

Portable track and rail extension ties have been used where the 52-cu.ft. cars are likely to bend or tip the regular slide rails. These extension ties use regular mine rail for slide rails except that they are inverted, using the bottom flange as the top of the slide rail. The tie sections as shown in Fig. 6 are such that the clips may be used for regular track, inverted slide rail track, or joint ties where the two sections are held together. With curved slide rails, curved sections may be used following the regular curve of the permanent track to which they may be attached.

For many years all loading was done in 14- and 16-cu.ft. mine cars. These cars are 48 in. high with inside body measurements of 24 or 26 in. wide, 24 in. deep, and 40 or 44 in. long. The hook-type car coupler, seen in Fig. 1, which is used to couple these cars to the loader, was developed here in 1932 for use on the two original loaders. Last year 52-cu.ft. Granby-type side-dump cars were put in service, which are satisfactorily loaded by the small loaders with the following changes: The dumping position of the bucket was raised by using higher rocker-arm racks and an extension on the dipper arm as illustrated in Fig. 7. The box-type couplers on these cars are built to swing to one side to

Fig. 6 . . . **RAIL EXTENSION** ties are here shown used in connection with slide rails. The setting of the clips for both regular rail and slide rail and for jointed sections is illustrated



BUCKET EXTENSIONS adopted to permit mucking machine to load into 30-cu.ft. mine car behind it are shown. Compare with Fig. 8

allow close coupling of the loader to the car. Dimensions of these cars are: 9 ft. 6 in. over couplers, and the inside body dimensions are 7 ft. long, 3 ft. 5 in. wide, and 3 ft. 2 in. deep.

Fig. 8 shows a loader of standard type equipped with car coupler and dipper-arm extensions to load into a 30-cu.ft. mine car. The body dimensions are 4 ft. 6 in. long, 2 ft. 8 in. wide and 2 ft. 6 in. deep. For a comparison of the loading of these cars, the average time per car and the number of buckets per car only are considered. It must be remembered that this time may vary, depending upon the operator and the type of ground.

Table III—Data on Loading Cars With Loaders

Car	Average Buckets Required	Average Time Required
14 or 16 cu.ft. (¾ ton)..	4¼	1 min. 0 sec.
30 cu.ft. (2 ton)..	11	2 min. 30 sec.
52 cu.ft. (4 ton)..	17	4 min. 0 sec.

Table IV—Average Loading Performance

	Loader			
	A	*B*	*C*	*D*
Average number buckets per small car.....	4¾	4¼	4¼	4¼
Average loading time per small car, seconds.....	80	55	60	60

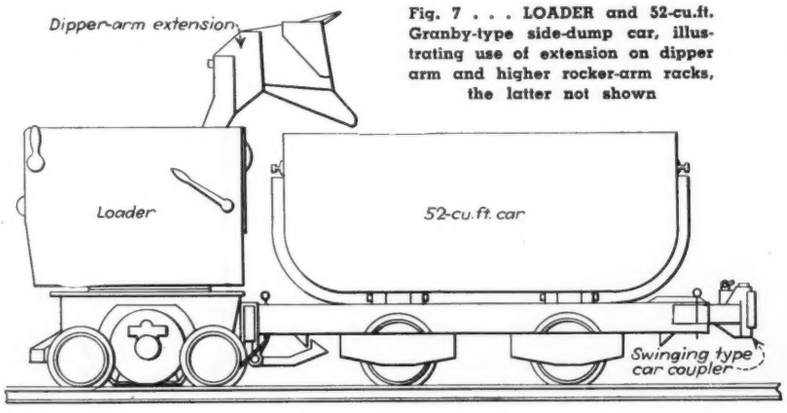
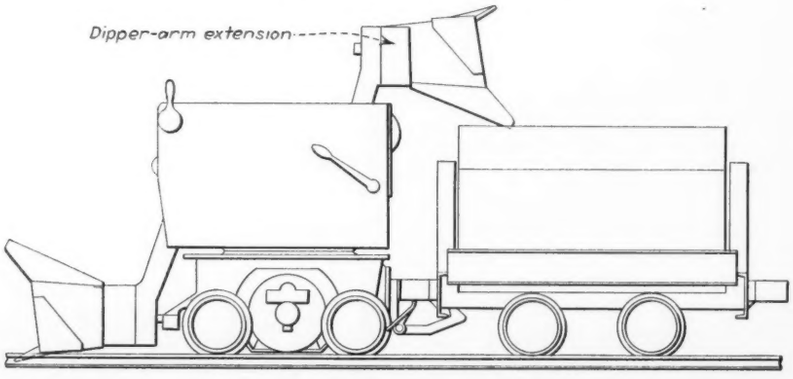


Fig. 7 . . . LOADER and 52-cu.ft. Granby-type side-dump car, illustrating use of extension on dipper arm and higher rocker-arm racks, the latter not shown

Fig. 8 . . . A STANDARRD LOADER equipped with car coupler and dipper-arm extensions for loading into 30-cu.ft. mine car



Also a slightly larger bucket is used for loading the 52-cu.ft. car. Table III shows the average number of buckets and the average time required to load the various sizes of cars:

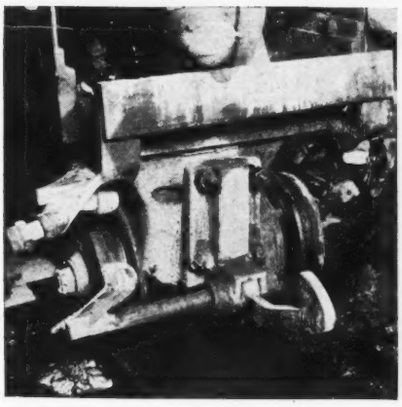
Table IV illustrates the difference in the performance of the various machines. As stated previously, the human element, the variation in operators' methods, and the type of muck being handled, are factors which must be considered in comparisons. There have been occasions when 30 cars have been loaded and trammed in 45 minutes, but this table shows an average condition.

Loader Records—Each loader is numbered before being put into underground service and this number is used for recording work and cost records of each machine. The form shown in Fig. 9 is used for keeping a record of the dates of loader repairs and transfers. A separate sheet is kept for each mine and also one for the Central Repair Shop.

A weekly report of each contract in which a mechanical loader is used is made by each mine. A summary report is compiled from these to show the total loader contract data for each mine. Costs per cubic foot and cubic feet per shift are calculated, using breaking excavation to compare with standard calculations used in other workings. Also the cost per cubic foot includes only the labor cost in the contract. Fig. 10 shows the headings used for these reports.

An underground machinist at each mine makes a biweekly inspection of each loader, lubricates it thoroughly, and fills out the report shown in Fig. 11. This form is printed in sets of triplicates and bound in books, 50 sets

COUPLING of 52-cu.ft. side-dump mine car, swung to one side to permit car to be close-coupled with loader



HOOK TYPE of car coupler, also shown in Fig. 1. It was developed at Butte in 1932 for use on the two original loaders

to a book. He also notes running repairs required, and parts replaced are noted under "Remarks." A grease gun and a supply of oil are kept with each loader to enable the operator to grease the machine and check the oil at the beginning of each shift. Overhauling and major repairs are done at a central machine shop which takes care of all loaders at the various mines.

General shop practice is to rebuild, weld, or hard-surface all worn and broken parts, such as buckets, rocker arms, side racks, couplers, shafts, axles, king pins, wheels, and other miscellaneous items. All parts are re-

(*Continued on page* 56)

_____ Mine

Fig. 9 . . . RECORD of dates of loader repairs and transfers

Machine Number	Type	Received From	Date	Sent to Repair Shop	Date	Trans. to Mine	Date	Remarks

Anaconda Copper Mining Company
Engineering Research Department
Lubrication and Inspection of Mechanical Loaders No._____
Mine_____ W. Place_____ Date_____
Type_____ A.C.M. No._____

Fig. 10 . . . FORM for reporting bi-weekly condition of each loader and lubricants used

Upper Deck		*Undercarriage*	
Centralizer		Car Coupler	
Rollers		Axles (front)	
King Pin		Axles (rear)	
Dipper Arm Rollers		Motor Throttle	
Motor Throttle		Drive Chains	
Control Lever & Cable		Sprockets	
Winding Reel Shaft			
Rocker Arm Cables (oil)			
Bucket Chains (oil)			

Top Motor	Add Thuban To Gear Cases When Needed Lbs. Bottom Motor Lbs. Gear Case	Lbs.
Top Motor	Change Thurban in Gear Cases Every 6 Weeks Lbs. Bottom Motor	Lbs.
Top Motor	Add Motor Oil to Motors When Needed Pts. Bottom Motor	Pts.
Top Motor	Change Oil in Motors Every 3 Weeks Pts. Bottom Motor	Pts.

Remarks

.....
.....
.....
.....
.....
.....

Original — to Research Dept.
Duplicate — to Mine Foreman
Triplicate — Remains in Book

LUBRICATED AND INSPECTED
By_____

Fig. 11 . . . WEEKLY REPORT of loader contract data for each mine

_____ Mine

Week Ending _____ 193 _____

Loader Number	Contract Number and Working Place		Cubic Feet Excavation			Cars Loaded	Shifts Worked	Amount Paid	Cu. Ft. per Shift
			Breaking	Timbering	Shoveling				

Cost per Cu. Ft.	Rate Day	Unit Prices			Advance and X-Section	No. Men in Contract	Total Men in Contract	Hand Mucking and Misc. REMARKS
		Breaking	Timbering	Shoveling				

All Mines

Week Ending _____ 193 _____

Mine	Total Sill Excavation	Per Cent Handled by Loaders	Cubic Feet Excavation			Total Cars	Shifts Contract	Amount Paid	Cu. Ft. per Shift
			Breaking	Timbering	Shoveling				

Cost per Cu Ft.	Rate Day	No. Units Equipment				Lin. Ft. Advance	No. Men in Contract	Total Men in Contract	Cu. Ft. Per Loader Day
		Mine	Shop	Idle	Used				

The Public Policies of International Nickel

The company's elaborate program determined by its varied and world-wide relations with governments, customers, stockholders, communities, and employees

ALTHOUGH the most important aspect of any company's public relations program deals with its attitude toward and treatment of employees, occasionally an example is found in which the international character of a business demands consideration also of the nationalistic policies of the countries in which the company operates. Under such conditions the public relations program becomes more complex and requires consideration of governments as well as of customers, stockholders, communities, and employees. A case in point is that of the International Nickel Company.

This company is Canadian in its incorporation. The majority of its stock is held in Canada and the United Kingdom, although it has a large number of shareholders, also, in the United States. All of the company's mines and most of its plants and expenditures are in Canada, but the greatest single market for its nickel production is in the United States, which normally takes half the company's output. The United Kingdom figures in the picture importantly both as producer and as consumer and distributer to Europe and other parts of the world. This multiple rôle is due to the merger of The Mond Nickel Company, Ltd., with The International Nickel Company of Canada to form the present INCO organization. Mond's nickel refinery at Clydach, Wales; the precious-metals refinery at Acton, London; and rolling mills at Birmingham and Glasgow, and its sales and distributing organization, thus became integral parts of the parent company.

From an industrial viewpoint INCO has a variety of relations. It mines and treats ore in a volume which makes it one of the world's largest mining enterprises. It operates four refineries and one conversion plant for separating and refining twelve distinct metals in commercial quantities. It operates rolling mills and a foundry for producing certain of these metals in commercial shapes. It owns two subsidiaries engaged in manufacturing finished products in which its metals are used. And it maintains an international organization of research, development, sales, and technical service to promote the industrial uses of the metals which it produces.

In this connection, the first point to consider is that, despite the fact that the company produces nearly 50 per cent more copper than it does nickel, and that it has become the world's largest producer of the platinum metals, nickel is the control metal in the company's policy. All other metals are considered as byproducts, their output depending on the amount of ore treated to produce the nickel for which markets can be developed.

The second point is that these markets are developed on the basis of *industrial* uses for the metal. This has been the motivating force since the election of Robert C. Stanley, now chairman and president, to the presidency in 1922. It has established nickel, primarily as an alloying element, in a steadily broadening list of industrial fields. It has been solely responsible for increasing world consumption of nickel from a low point of less than 20,000,000 lb. in 1922 to 240,000,000 in 1937.

Despite this acceptance of nickel by the industrial world, the general public has not yet completely lost its prejudice that the metal is essentially a war material, a striking example of the patience and persistence required to change public opinion. One might hold that this prejudice could be ignored in view of the steady increase in sales to industry; but the public votes as well as buys.

Relations With Canada—From the national public relations standpoint Canada is the most important country. All of the company's mines and most of the plants are in the Dominion, as are some 60 per cent of all employees. The dominant Canadian interest in the company is in terms of ore deposits and of primary production from these ores. The position of the company in the Dominion's economy is outstanding. Unlike most mining enterprises which are relatively temporary in nature, it has proved ore reserves sufficient for years to come. In developing the mines which tap these reserves, the company buys many million feet of Canadian lumber each year, as well as vast quantities of other supplies manufactured within the Dominion. The concentrator and smelter at Copper Cliff, Ontario, are topped by the two tallest stacks in the British Empire. Nova Scotian coal is consumed at the annual rate of about 250,000 tons. The company is among the largest purchasers of electric power and the heaviest shippers by rail.

As less than 2 per cent of its nickel production is sold in Canada, the company is primarily a factor in export trade, bringing into the country many millions of dollars for payrolls, supplies, power, freight bills, taxes, and dividends to Canadian shareholders.

The company is developing its public relations in Canada through a policy of full, frank, and frequent reports to its shareholders (and the public), through institutional advertising in the newspapers and magazines, and through sound films produced for motion picture theaters.

Shareholders receive each year the annual report, which is notable for the fullness of its text and accounting; the president's address to shareholders at the annual meeting; quarterly financial statements for each of the first three quarters; a special letter from the chairman and president with each of these statements, and the president's annual review of the nickel industry, which is a detailed summary of significant developments in the uses of nickel and nickel alloys in world industry. These various documents are also distributed to the press and other media of public information.

The institutional advertising, now in its seventh year, consists of a series of full-page advertisements appearing in 44 newspapers and periodicals. The theme of the current series is the prevention of breakdowns through the use of nickel alloys for equipment parts.

Three one-reel films with sound have been produced primarily for showing in the Canadian theaters, the purpose being to bring home to Canadian audiences the extent of the nickel operations, the difficulties encountered in mining and treating the complex ores, the extensive use of Canadian labor and supplies, and the part which Canadian nickel is playing in industry the world over. These films have a record of showing in more than 90 per cent of all the theaters in the Dominion. "This Changing World," the latest in the series, was so successful that it has been introduced into American theaters with a slight revision.

An illustrated magazine, "The Inco Triangle," is published bi-monthly for the benefit of the Canadian employees. It has no public circulation, except as it is taken home and read by the families and friends of the workers.

When the British Empire Economic Conference met at Ottawa in 1932, a 44-page illustrated booklet, entitled "The Story of Nickel," was distributed to all the delegates, as well as to Canadian officials and editors, to present the case for free world markets for nickel. The booklet was later reprinted in a popular edition.

The annual meeting of the Canadian Institute of Mining and Metallurgy in 1933 was made the occasion for celebrating the fiftieth anniversary of the Canadian nickel industry. Mr. Stanley and Premier Bennett were the guest speakers at the annual dinner, their speeches being broadcast on a Dominion-wide hook-up; and papers on various phases of the nickel industry were featured in the technical sessions. To commemorate the anniversary, the company established for award by C.I.M.M. a platinum medal for conspicuous service to the mining and metal industries of Canada. The medal was modeled by R. Tait MacKenzie, distinguished Canadian sculptor; and it has become the most prized award of the Canadian Institute. It is generally referred to as "the INCO platinum medal."

Although an important part of the company's productive plant is situated in the United Kingdom, the main public relations problems there are in popularizing industrial uses of nickel and in maintaining healthy personnel relations in the various works and offices. These parts of the program are discussed in the following.

Naturally, the British shareholders (and the press) receive the same literature as that regularly distributed in Canada and in the United States.

The main objective of the public relations program in the United States is to sell more nickel. Even though approximately 100,000,000 lb. were sold in 1937, American industry is by no means saturated with nickel and nickel alloys. There are three production units in this country, and labor relations necessarily loom large in the company's program.

The principal American unit is the Monel conversion plant and non-ferrous rolling mill at Huntington, W. Va., where Monel is produced from special Canadian matte, and where this alloy, pure nickel, and the nickel-chromium alloy, Inconel, are rolled into standard commercial shapes. The other two producing units are a foundry at Bayonne, N. J., and a plant at Cambridge, Mass., for manufacturing Monel hot-water storage tanks.

Research, Development and Marketing

In 1922 nickel, which had become almost a precious metal through the exigencies of war-time demands, surfeited the market. Production facilities had been greatly expanded, unused war stocks were still to be liquidated, and the then most important field of consumption had been destroyed by the disarmament conference. Popularly considered a war material, nickel had small place and few friends in a world revulsion against war. Scarcely seventeen years later nickel has become so inextricably woven into the fabric of world industry, that much of the performance which we now expect in transportation, communications, and manufactured products depends on uses of that metal.

How this about-face in the status of nickel has been achieved in so short a time is one of the great examples of successful public relations. It is based on a policy of first learning, then doing, and finally talking. Thoroughgoing research was instituted into the properties of nickel alone and as a constituent of various alloys. What was learned was carefully tested in the laboratory, then demonstrated under conditions of commercial production, and finally made the text of intensive educational programs in the appropriate industries. As one application after another was successful, other industries became interested in seeing what they could do in related or similar spheres of industrial enterprise. Metallurgical research was stimulated in various fields. The age of alloys began to take form, and nickel held its place as a common denominator among many of the new metallic combinations.

Behind this development there has been a single dominant leadership which is inspired by faith in the product and faith in research, development, and advertising. The research laboratory at Bayonne, N. J., has twice been expanded and modernized to keep pace with the demand for ever more exact knowledge of nickel and nickel alloys, and of their behavior under even more exacting conditions of use. Since the incorporation into INCO of the Mond company, its laboratory at Birmingham, England, has greatly strengthened research facilities. This laboratory, which also was recently enlarged, is said to be the largest and most modern institution of its kind to be maintained by any industrial corporation overseas. These research facilities have been further strengthened by the construction of a modern laboratory at Copper Cliff, Ontario.

Supplementing the research staffs both here and abroad are corps of metallurgists whose function it is to offer technical service to industries in the introduction and adaption of nickel and nickel alloys to their special needs.

The success of the technical service has been such that the New York headquarters of the development and research division can no longer handle the requests for aid, and branch offices have therefore been established in Detroit, Chicago, Pittsburgh, Los Angeles, Hartford, and Toronto.

Further expanding this missionary work to world industry, nickel information bureaus have been established in Paris, Brussels, Milan, Frankfort, and Tokyo. These outposts are centers for collecting and referring back to headquarters information on important metallurgical developments in their territories, and for translating and circulating to their constituencies pertinent reports and literature. Thus the whole industrial world is covered.

Supporting this distribution of personal service is the program of trade and technical magazine advertising, direct-by-mail circulation of reports and leaflets, and the publication of periodicals for free distribution to specially prepared mailing lists which, in certain instances, contain more than 100,000 names.

Personnel Relations—At the end of 1937 the company's employees totaled 17,434, distributed as follows: Canada, 11,486; Great Britain, 3,421; United States, 2,472; other countries, 55. Each of the main geographical divisions has its own living standards and labor psychology. Each type of employment has its own working conditions. Thus the personnel programs differ in detail with plant location and activity, but there are certain general policies. These are:

1. *Retirement System*: Established Jan. 1, 1928, for all employees, it is financed by the company and provides for disability retirement as well as for service retirement, and also for death benefits. Government bonds to the amount of nearly $13,000,000 are currently held against the retirement system reserve.

2. *Non-occupational Insurance*: The company provides for contributory non-occupational accident and sickness

insurance benefits for all its employees, who are paid on an hourly basis. This insurance provides a weekly income during absence from work as the result of non-occupational accident or illness. The company contributes approximately half the premium cost. Although the plan is optional, nearly 98 per cent of eligible employees have elected to participate.

3. *Group Life Insurance*: The company has made available to all employees in the United States and Canada a group life insurance program which permits them to take out insurance at group rates. Upwards of 10,000 employees have taken advantage of this opportunity.

4. *General Welfare*: During the last nine years the company has expended more than $1,000,000 for recreational and welfare facilities and athletic activities. This is in addition to all operating expenditures having to do with protecting the health and welfare of employees while actually at work, and also is in addition to the accident and sickness insurance and to the reserves maintained for the retirement system.

5. *Twenty-five Year Clubs*: Although the present corporate structure is less than ten years old, it contains elements which date back nearly fifty years in the case of the Canadian Copper Company and more than a century in that of the Wiggin Works, in Birmingham, England. The average service age of the president, four vice-presidents, and secretary-treasurer is almost 30 years, and this length of service is reflected in a notably stable personnel. The twenty-five year clubs in Canada, the United Kingdom, and the United States, which currently have a total membership of 591 persons, have therefore become an important factor in the company's tradition, and their annual dinners and welcoming of new members have become notable occasions.

6. *Inter-plant Education*: With so far-flung an international organization, including several units important in themselves, it has become increasingly difficult for the individual, or even the group, to visualize the entity and accept his or its relation to the whole. To overcome this difficulty a series of motion picture films has been prepared for showing to employee audiences. Each of these films depicts the plant and processes of a particular unit, thus providing an opportunity for the men of the rolling mill at Huntington, W. Va., for example, to understand the extent of operations in the rolling mill at Birmingham, England, and the staff of the electrolytic nickel refinery at Port Colborne, Ontario, to appreciate the part which the Mond refinery at Clybach, Wales, plays in producing Canadian nickel for world markets.

Vertical Angles With Top Telescope With Non-Parallel Lines Of Sight

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University of California
Berkeley, Calif.

THE CONVENTIONAL method for correcting for the eccentricity of the top telescope involves making the lines of sight of the two telescopes parallel. The correction is computed. An instrumental method for correcting the vertical angle with non-parallel lines of sight was published in *Engineering and Mining Journal* in November, 1937.[1] This paper is a discussion of a method for computing the correction angle when the lines of sight are not made parallel. It will be assumed that the lines of sight converge, but not enough to intersect within the line of sight. The lines of sight may be made to do this by moving the reticule slightly.

Consider the illustration. The heavy lines represent the two telescopes. The top telescope is looking at the point *P*. The vertical angle read on the vertical circle is α. It is desired to find the angle that would be read if the main telescope were looking at point *P*.

The line *DF* is perpendicular to line of sight of the main telescope and *DE* is perpendicular to the line of sight of the top telescope. *AC* is perpendicular to the line of sight of the top telescope. *FA* is parallel to *DB*, the line of sight of the main telescope, and *DC* is parallel to *FP*, the line of sight of the top telescope.

The angle ϕ is the angle that the two lines of sight make with each other. If *DF* is represented by *K*, then $DE = K \cos \phi$.

The correct vertical angle is α, the angle read, plus θ.

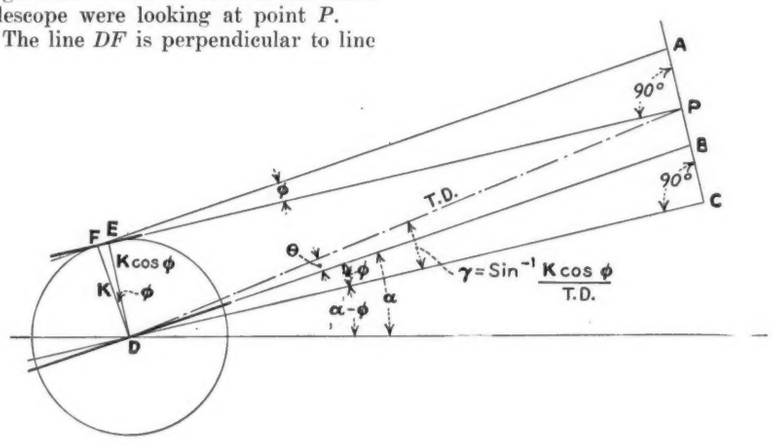
$\theta = \gamma - \phi$ and $PC = K \cos \phi$.

$\gamma = \sin^{-1} \frac{K \cos \phi}{T.D.}$ where *T.D.* is the tape distance.

Then $\theta = \sin^{-1} \frac{K \cos \phi}{T.D.} - \phi$.

To Determine ϕ and $K \cos \phi$—Drive two stakes on line with the instrument, one close to the instrument and one two hundred feet away. Using the main telescope as a level, drive the stakes until their tops are at the same elevation. Take a rod reading on one of the stakes with main telescope when it is level.

Now tip up the telescope until top telescope gives same rod reading on both rods. The top telescope is then level. The rod reading now obtained with top telescope minus the rod reading taken with the main telescope, when it was level, is $K \cos \phi$, and the angle through which the telescope was raised to make top telescope level is ϕ.



If it is desired to look up a raise at an angle α with the top telescope, set the vertical circle at $\alpha + \phi$. The top telescope then makes an angle α with the horizontal.

If it is desired to know where the sight of the main telescope would hit the plumb bob string if the main telescope made an angle α with the horizontal, measure down from the point hit by the top telescope when vertical circle was set at $\alpha + \phi$, a distance equal to $\frac{K \cos \phi}{\cos \alpha}$.

[1] Weeks, Walter S. and Ramsden, Charles D.: "Correcting Vertical Angles When Top Telescope is Used." *E. & M. J.*, Nov., 1937, p. 39.

Electrostatic Separation—III

The Process, Recently Improved, Now Invites Wider Application

Herbert Banks Johnson
Vice-President, Ritter Products Corporation
Rochester, N. Y.

▶ THE DEVELOPMENT *of the art of electrostatic separation as a process for use in ore preparation, with special attention to its patent history, has been described in the two preceding installments of this article, published in the September and October issues, respectively. The account thus given has brought the story down to the successful use of the Huff process in concentration work over a period of years and its subsequent eclipse by flotation. The present installment deals with the revived use of electrostatic separation, improved not only as to equipment but also by the discovery, recently made, that it is possible to reverse the polarity of the electrostatic charge on many of the common economic minerals, thereby facilitating the separation. The author frankly looks forward to a greatly extended application of the process.*

DEVELOPMENT of static separation and the commercial development of electrostatic separation known as the Huff process have been covered briefly in Part I and Part II of this article. The account thus far given brings us to approximately the year 1930.

In this final article I shall endeavor to cover the further improvement of the Huff process out of which developed the Johnson process and the new art of selective electrostatic separation which involved an expenditure in research, engineering, and equipment cost of approximately $200,000.

Reference has been made to several important installations in the food industry. Separation and cleaning of food products, seeds, grains, and the like presented many new problems and required new designs. The difference in electrostatic behavior is somewhat affected by the shape, condition, and other characteristics of the particles, such as the moisture content and degree of ripeness or growth of the grains and seeds at harvest time as well as changes taking place during storage.

The separation of food materials, seeds, and grains from sand, stones, glass, and metallics is comparatively simple and is well done by several well-known, air-gravity machines which have been in successful operation many years. Separation of fully matured seeds and grains from partly matured ones and elimination of foreign seeds, weed seeds, animal excreta, and other objectionable impurities where there is little if any difference in specific gravity offer a wide and profitable field for research and investigation. My experience in this field during the past eight years has resulted in many changes and improvements in the design of electrostatic equipment, including the preconditioning of materials before separation. Many food materials require special feeding devices to assure a smooth mechanical flow through the electrostatic field in order to produce a separation.

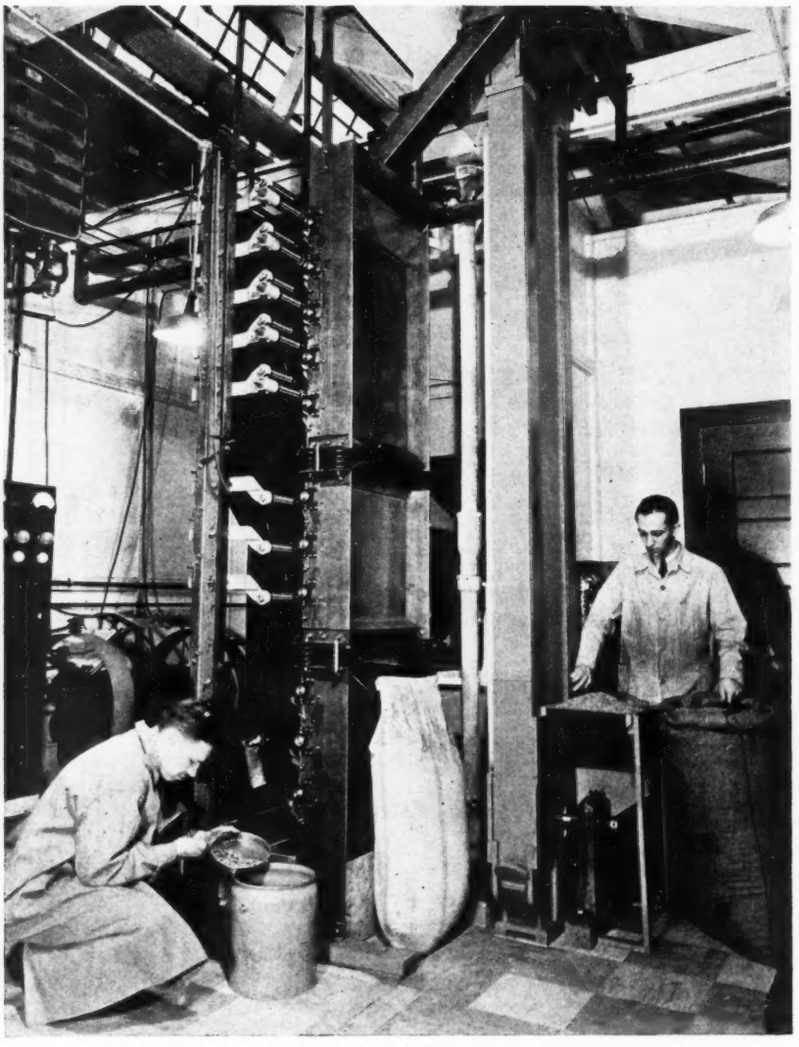
The time required for many materials to receive an electrostatic charge differs widely. Many food materials, if allowed to accumulate in any separating device, rapidly deteriorate and become infested. The explosive hazards are much greater than in the mining and chemical industries and better electrical insulation must be provided. This experience developed a different conception of the commonly used terms—conductors and non-conductors—generally referred to as metallic and non-metallic minerals in the mining industry.

Having made these improvements in equipment, it is only natural that my association with concentrating problems in the mining industry excited my interest in determining what effect, if any, these changes in design might have for the separation of minerals. Previously I had spent some time on the electrostatic separation of limestone and chert, but with negative results. Later I tried for several months to concentrate the calcite and quartz associated in the cement rock deposits of the Lehigh Valley district of Pennsylvania, where the lime content is usually too low to meet many portland cement specifications, necessitating the purchase of limestone at a considerable additional expense per barrel of cement. This work, likewise, was only partly successful and of no real commercial importance. In both cases the regular Huff process type of equipment was used. I mention these two separating problems now because I wish to refer to them again later.

Looking for a diversified business, the Ritter Dental Manufacturing Company of Rochester, N. Y., became interested in the Johnson process and in the progress made with electrostatic separation in the food industry. A complete and moden research laboratory was established in Rochester early in 1936, and since then continuous research and improvement in equipment design have been in progress. At the present, four different types of electrostatic separators, in three sizes and three types of electrical equipment, are available through the company's subsidiary, the Ritter Products Corporation, also of Rochester.

After this new laboratory began operations and the new Johnson process equipment was available, I again became interested to learn what would be accomplished by the new equipment in the separation of calcite, quartz, and alumina minerals associated in the Lehigh Valley cement rock. On previous tests I had been unable to increase the $CaCO_3$ content more than 2 or 2.5 per cent from 72 to 75 per cent or 76 to 77.5 per cent. In reseparating a quartz tailing product, made in the usual way as a non-repelled product of separation, the polarity of the electrostatic charge at the electrode was reversed, and, due to the fact that the quartz particles greatly outnumbered the calcite particles, I was surprised to note, through microscopic examination, that the quartz was being cleanly repelled as a concentrate.

Now, since the beginning of the development of the Huff process in 1901, it always has been customary to try both positive and negative po-



IN THE LABORATORY for electrostatic testing directed by the author at Rochester, N. Y. The separator shown differs from a commercial installation only in its width

larities for each separation. The polarity finally selected for commercial separation was simply the one which repelled the strongest and indicated the best possible recovery, but up until this time I had never known nor had I ever heard of the minerals themselves reversing in separation when the polarity was changed. If in some of the old Huff plants the reversal of polarity had caused the concentrates to report in the tailing dumps and the tailings to report at the smelter, I am sure we would have learned about the discovery promptly and undoubtedly would have been compelled to make some adjustments in royalty payments.

Further tests and microscopic examination of the separated products confirmed the discovery — namely, that a positive charge repelled the quartz and suppressed the calcite, whereas the reverse, or negative charge, repelled the calcite and suppressed the quartz. In more conclusive tests I also noticed that the minerals high in alumina content were not affected in the same manner as the quartz and calcite but were repelled as concentrates by either polarity.

The associated country rock (locally called limestone) and amounting to 70 to 75 per cent of the whole, likewise was not affected by changes in polarity. This presented an entirely new method of separation control for the Lehigh Valley cement rock: two minerals not affected by polarity, one mineral better controlled with a positive polarity and the other better controlled with a negative polarity. Chemical analyses of the separated products definitely confirmed this new separation control, and the problem was greatly simplified.

Using a positive charge with this method, the excess silica and alumina minerals could be repelled together (approximately 5 to 12 per cent by weight), increasing the limestone ($CaCO_3$) content of the raw mix, the separation being closely controlled and affected at low cost as compared to the purchase of limestone. Furthermore, the use of different polarities to compensate for the variation in analyses of the crude cement rock suggested the simplification of the recombination of the separated products to meet various portland cement specifications.

Many tests proved the possibility of increasing the $CaCO_3$ content from 74 to 85 per cent with a high recovery of lime.

I next made further tests on the limestone and chert referred to in the foregoing and secured an excellent separation, although previously with the Huff process equipment it had been impossible. After careful examination of our new electrical equipment and separator, I learned how further to improve this new type of separation. As a result, I became much interested in learning what the new application would offer in the separation of other minerals.

A list of the most common minerals was obtained from Ward's Natural Science Establishment, in Rochester, and a selection made primarily for purity. Special equipment for measuring voltage (approximate electrostatic conductivity) was designed and each mineral tested to determine its behavior under a positive and a negative polarity. This work offered a new conception of electrostatic conductivity and the behavior of minerals in a selective electrostatic field.

For example, out of the 90 minerals tested, 52 were not affected by the use of either a positive or a negative polarity. Twenty minerals were repelled with a positive charge and suppressed with a negative charge. Eighteen minerals showed the opposite action; that is, they were repelled with a negative charge and suppressed with a positive charge.

Next I made a search of books, technical papers, publications, and patent specifications for further enlightenment on the subject, but nothing of important significance was found. However, there are two or three early patents, now expired, in which the inventors vaguely referred to observations indicating that some materials appeared to be more responsive to a negative charge than to a positive one or to changes used in polarity. None of these inventors apparently considered the subject of sufficient importance to investigate and actually tabulate the minerals or materials. Nor did they discover that there were three general groups; namely, reversible positive, reversible negative, and non-reversible materials which could be so classified and which offered more positive and selective electrostatic separation control. Furthermore, I found no suggestion or teaching in these patents to indicate that a group of minerals may be passed through a specially constructed separator, permitting some of the material-conveying electrodes to be in-

sulated from the others, so that different polarities may be used with a definite knowledge of what may be expected in the behavior of the minerals in one continuous separation procedure.

I was so impressed with the possibilities of a new mineral conductivity list and its practical usefulness that I consulted several experts in ore dressing and concentrating fields, including my highly respected and good personal friend Charles E. Locke, professor of ore dressing at Massachusetts Institute of Technology, who has been in close touch with electrostatic separation since the early days of the Huff process. Professor Locke saw the value of the new information and recommended that I prepare a paper to be read before the American Institute of Mining and Metallurgical Engineers at the February, 1938, meeting. I am grateful to him and also to F. Ritter Shumway for valuable assistance in the final preparation of the mineral conductivity list as subsequently published.

The Ritter corporation maintains in Rochester probably the most modern electrostatic testing laboratory in the country, where samples from many industries are being tested continuously. Separations may now be made with more definite knowledge of procedure and more positive control, especially in duplicating in plant operation the separating efficiency indicated by laboratory tests.

The mineral conductivity table is presented for convenience of reference in connection with certain comments which I wish to make regarding the practical use to which this list may be put by research engineers as a reference and guide in the daily conduct of tests.

The accompanying tabulated list shows that only the more common minerals were selected. They have been arranged in groups, marked with the location, voltage (approximate surface conductivity), and behavior of each mineral while in the influence of an electrostatic field. Some variation may occur in the same mineral from different formations and localities and due to the combination with other elements. In making the tests for this list, the size of particles, temperature, and method of measurement were maintained as constant as was possible.

In their testing work the Ritter corporation's research engineers have made some remarkable separations with the electrostatic equipment of the new design. Formerly it was thought possible to separate two minerals only when the difference in their relative electrostatic conductivity was 3,500 volts or more. Now, however, by means of the new equipment which utilizes the discovery of the reversibility of minerals in an electrostatic field, two minerals which have nearly the same relative electrostatic conductivity can often be separated provided that one is reversible positive or negative and the other non-reversible or provided that they are each reversible at opposite signs. For example, marcasite, No. 20, voltage 5460, non-reversible, is easily separated from cryolite, No. 23, voltage 5,460 reversible positive, if a positive polarity is used. A negative polarity will not permit a clean separation because the cryolite is suppressed and difficult to separate from the marcasite. Bituminous coal, No. 83, voltage 4,056, reversible positive, is easily separated from anthracite, No. 82, voltage 3,588, non-reversible, when a positive polarity is used. A negative charge will show practically no separation, because the bituminous coal is suppressed and at this polarity will remain with the anthracite, both being repelled almost equally.

Recently a good separation has been made of a lead-silver, zinc, quartz ore.

Table I—Mineral Conductivities[1]

No.	Mineral and Chemical Composition	Source	Voltage	Reversible[2]
	Native Elements			
1	Flake graphite, C	Texas	2,800	Non
2	Graphite-plumbago, C	Ceylon	3,588	Non
3	Sulphur, S	California	10,920	RP
4	Arsenic, As	Canada	6,552	Non
5	Antimony, Sb	California	7,800	Non
6	Bismuth, Bi	Canada	4,680	Non
7	Silver ore, Ag	Cobalt	6,552	Non
8	Iron in basalt, Fe	Germany	7,800	Non
	Sulphides of the Semi-metals			
9	Stibnite, Sb_2S_3	Nevada	6,864	Non
10	Molybdenite, MoS_2	Colorado	7,020	Non
11	Galena, PbS	Oklahoma	6,864	Non
12	Chalcocite, Cu_2S	Alaska	6,552	Non
13	Sphalerite, ZnS	Oklahoma	8,580	RN
14	Niccolite, NiAs	Cobalt	7,800	Non
15	Pyrrhotite, Fe_8S_9 to $Fe_{16}S_{17}$	Canada	6,552	Non
16	Bornite, Cu_5FeS_4	Transvaal	4,680	Non
17	Chalcopyrite, $CuFeS_2$	Arizona	4,680	Non
18	Pyrite, FeS_2	Utah	7,800	Non
19	Smaltite, $CoAs_2$	Canada	6,396	Non
20	Marcasite, FeS_2	Oklahoma	5,460	Non
	Haloids			
21	Halite, NaCl	Prussia	4,056	Non
22	Fluorite, CaF_2	Illinois	5,148	Non
23	Cryolite, Na_3AlF_6	Greenland	5,460	RP
	Oxides of Silicon			
24	Quartz, chert, SiO_2	Missouri	8,892	RN
25	Quartz, smoky, SiO_2	Colorado	9,672	RN
26	Quartz, flint, SiO_2	England	10,140	RN
27	Quartz, gold, SiO_2	Dakota	10,140	RN
28	Quartz, crystal, SiO_2	Brazil	13,416	RN
29	Quartz, milky, SiO_2	Pennsylvania	14,820	RN
30	Quartz, rose, SiO_2	S. Dakota	14,820	RN
	Oxides of Metals			
31	Corundum, Al_2O_3	Transvaal	13,728	Non
32	Hematite, Fe_2O_3	England	6,240	Non
33	Ilmenite, $FeTiO_3$	India	7,020	Non
	Intermediate Oxides			
34	Magnetite sand, $FeO.Fe_2O_3$	California	7,800	Non
35	Franklinite, (Fe,Zn,Mn)O. $(Fe,Mn)_2O_3$	New Jersey	8,112	Non
36	Chromite, $FeCr_2O_4$	S. Rhodesia	5,616	Non
37	Rutile, $(TiO)TiO_3$	Virginia	7,332	Non
38	Pyrolusite, MnO_2	New Mexico	4,680	Non
39	Manganite, MnO(OH)	California	5,616	Non
40	Limonite, $2Fe_2O_3.3H_2O$	Alabama	8,580	Non
41	Bauxite, $Al_2O_3.2H_2O$	Tennessee	8,580	RN
	Carbonates			
42	Calcite, $CaCO_3$	Montana	10,920	RP
43	Calcite, $CaCO_3$	Missouri	10,920	RP
44	Dolomite, $CaMg(CO_3)_2$	New York	8,268	RP
45	Magnesite, $MgCO_3$	Greece	8,580	RP
46	Siderite, $FeCO_3$	Connecticut	7,176	Non
47	Rhodochrosite, $MnCO_3$	Montana	8,580	Non
48	Smithsonite, $ZnCO_3$	New Mexico	12,480	RN
49	Aragonite, $CaCO_3$	California	14,800	RP
	Silicates			
50	Microcline, $KAlSi_3O_8$	Canada	7,488	Non
51	Oligoclase, $n(NaAlSi_3O_8)M(CaAl_2Si_2O_8)$	N. Carolina	6,240	RN
52	Labradorite, $(NaAlSi_3O_8)(CaAl_2Si_2O_8)_3$	Laborador	4,992	Non
53	Enstatite, $MgSiO_3$	Transvaal	7,800	RN
54	Pyroxene, $RSiO_3$	Canada	6,084	RN
55	Amphibol-hornblende, $Ca(Mg,Fe)_3(SiO_3)_4$	Canada	7,020	RN
56	Nephelite, $K_2Na_6Al_8Si_9O_{34}$	Canada	6,240	Non
57	Garnet, $R_3R_2(SiO_4)_3$	New York	18,000	Non
58	Rhodolite, $2Mg_3Al_2(SiO_4)_3Fe_3Al_2(SiO_4)_3$	N. Carolina	16,380	RP
59	Almandite, $Fe_3Al_2(SiO_4)_3$	New York	12,480	Non
60	Chrysolite, $(Mg,Fe)_2SiO_4$	N. Carolina	9,204	RP
61	Zircon, $ZrSiO_4$	N. Carolina	11,700	RN
62	Topaz, $(AlF)_2SiO_4$	Virginia	12,480	RP
63	Kyanite, Al_2SiO_5	Connecticut	9,204	Non
64	Axinite, $H(Ca,Fe,Mn)B(Al,Fe)_2(SiO_4)_4$	France	10,296	RN
65	Calamine, $H_2Zn_2SiO_5$	Missouri	9,048	Non
66	Tourmaline, $H_9Al_3(B.OH)_2Si_4O_{19}$	California	7,176	RN
67	Muscovite, $(H,K)AlSiO_4$	Pennsylvania	2,964	RP
68	Lepidolite, $(OH,F)_2KLiAl_2Si_3O_{10}$	S. Dakota	4,992	Non
69	Biotite, $H_2K(Mg,Fe)_2Al(SiO_4)_3$	Canada	4,836	Non
70	Serpentine, $H_4Mg_3Si_2O_9$	New York	6,084	RP
71	Talc, $H_2Mg_3(SiO_3)_4$	N. Carolina	6,552	Non
72	Kaolinite, $H_4Al_2Si_2O_9$	S. Carolina	6,708	RN
73	Bentonite	Wyoming	3,588	Non
	Phosphates			
74	Monazite sand, $(Ce,La,Di)PO_4$	N. Carolina	6,552	Non
75	Apatite, $(CaF)Ca_4(PO_4)_3$	Canada	11,700	RP
	Sulphates			
76	Barite, $BaSO_4$	S. Carolina	5,772	Non
77	Anhydrite, $CaSO_4$	N. Brunswick	7,800	RP
78	Gypsum, $CaSO_4.2H_2O$	Michigan	7,644	RP
	Tungstates-Molybdates			
79	Wolframite, $(Fe,Mn)WO_4$	England	7,332	Non
80	Scheelite, $CaWO_4$	Nova Scotia	8,580	Non
81	Wulfenite, $PbMoO_4$	New Mexico	11,700	Non
	Hydrocarbon Compounds			
82	Anthracite	Pennsylvania	3,588	Non
83	Bituminous coal	Pennsylvania	4,056	RP
84	Bituminous coal, coking	Virginia	6,240	RP
	Artificial Abrasives			
85	Aluminous oxide	New York	13,572	RP
86	Silicon carbide	New York	5,616	Non
	Beach Sands			
87	Rutile	Australia	7,488	Non
88	Zircon	Australia	11,076	RP
89	Rutile	India	8,892	Non
90	Zircon	India	11,076	RP

[1] Reprinted from T.P. 877, A.I.M.E., February, 1938.

[2] The meaning of the terms in this column is as follows: Non, not reversible, RP, reversible positive, and RN, reversible negative.

Table II—Cost of Drying

Five tons per hour, material similar to ore concentrates, averaging 10 per cent moisture and dried to a fraction of 1 per cent, operating 24 hr. daily:	
Cost of drying equipment installed	$10,000
Fixed charges per ton dried material	0.042
Operating charges per ton dried material	0.304
	$0.346
Twenty-five tons per hour, same type material and moisture content, operating 24 hr. daily:	
Cost of drying equipment installed	$22,500
Fixed charges per ton dried material	0.019
Operating charges per ton dried material	0.144
	$0.163
Fifty tons per hour, same type material and moisture content, operating 24 hr. daily:	
Cost of drying equipment installed	$40,000
Fixed charges per ton dried material	0.017
Operating charges per ton dried material	0.093
	$0.110

By referring to the mineral list, we can arrive at a procedure which offers the best solution. For example:

Group A	Group B
Most conductive (Non-reversible)	Less conductive (Reversible negative)
Silver, 6,552 volts	Sphalerite, 8,580 volts
Galena, 6,864 volts	Quartz, 8,892 to 14,820 volts

There is approximately 2,000 volts difference between Group A and Group B, which usually is not enough of a difference to assure a satisfactory separation. But a positive charge suppresses the minerals in Group B, whereas the minerals in Group A are not strongly influenced by either polarity. Therefore, the cleanest lead-silver concentrate can be made by using a positive charge and repelling the non-reversible minerals.

If the variety of quartz is nearer 14,820 volts than 8,892, a further separation of the zinc and quartz is obtainable by using a negative charge at a voltage potential which will repel the zinc but not the quartz. By adopting this formula or procedure, a clean lead-silver concentrate is produced and also a clean zinc product. This separation requires only one pass through the new type Johnson process selective separator; a good recovery is made and the separation cost is low.

Another unusual and hitherto impractical separation has been made on a flotation concentrate composed of chalcopyrite, pyrite, and quartz. Referring to the mineral list we find that chalcopyrite, No. 17, 4,680 volts, is non-reversible; pyrite, No. 18, 7,800 volts, is non-reversible, and that quartz varies in voltage from 8,892 to 14,820, depending upon the type, and is reversible negative. We therefore will succeed best if we use a negative charge and repel the quartz, leaving the cleaner chalcopyrite and pyrite as a non-repelled product for separation.

The difference in voltage between chalcopyrite and pyrite is 3,120, which usually will permit a clean separation. Both minerals are non-reversible. But, as the chalcopyrite is more conductive than the pyrite, if we wish to obtain a clean chalcopyrite and are not as particular about the grade of the pyrite, we should use a positive charge which will suppress the remaining quartz and leave it with the pyrite as a non-repelled product.

It will be seen that many separations and mineral combinations can be positively controlled and several products produced by one combined polarity separating unit which has been developed in connection with the Johnson process. In many separations, especially when handling large tonnage, this new equipment assures a saving in elevating and rehandling expense, also in building space, and in some cases redrying expense, thereby contributing to lowest separation cost per ton.

In further explanation of the new mineral list and its use, formerly mineral conductivity lists have referred only to "good conductors" and "poor conductors," usually listing the more valuable (metallic minerals) as good conductors and the non-metallic, or usually gangue minerals, as poor conductors. Therefore, quartz, fluorspar, feldspar, calcite, and other generally called "non-metallic" minerals have been considered poor conductors or non-conductors. It has been customary to classify the minerals which are repelled in separation as good conductors; those not repelled at suitable separating potential have been classified in the past as poor conductors.

Examination of this mineral list shows that by applying the proper polarity many so-called non-metallic minerals may be repelled more readily than the metallic minerals. We now have three classifications of minerals —good conductors, poor conductors, and reversible conductors, the last mentioned being a new classification which includes both the so-called metallic and non-metallic minerals in native elements, sulphides of the semi-metals, haloids, oxides of silicon, silicates, phosphates, and metal oxides.

A mineral designated "RN" is one that it is repelled by a negative charge at the material-conveying electrode. The designation "RP" indicates that the mineral is repelled by a positive charge. Usually by using the reverse charge to that designated for a mineral, the repelling action is suppressed. Many mineral combinations may be worked out from this mineral list and good indications of electrostatic separation possibilities may be forecast with reasonable accuracy.

Little has been published about electrostatic separation cost, probably because few persons have had access to operating data and general information about the equipment used commercially. Any costs which have been published referred to small-tonnage operations where, naturally, on account of the low capacity, the drying cost was so high as to be prohibitive for many materials of low value.

Approximate Drying Cost—Usually it is necessary to dry before electrostatic separation, especially for most ores and mineral combinations, whether natural or artificial. The drying operation is necessary for three reasons:

First, to assure a free flowing of the material mechanically through the electrostatic separating fields.

Second, to permit the particles in the electrostatic field to move freely and independently in quick response to the degree of conductivity or reversibility, thereby allowing free separation while in the influence of the electrostatic charge.

Third, because electrostatic conductivity is principally a surface action and excess moisture often changes the electrostatic behavior of minerals, a constant and true surface conductivity must be maintained. The surface of the mineral at least should be practically bone-dry while passing through the separator to assure most efficient and constant separating control.

This drying operation does not necessarily mean that all the moisture must be eliminated. I have known of several good separations, made electrostatically, where what I term "flash-drying" of the particle surface only was necessary and the internal moisture amounted to 2 or 3 per cent. The material, however, was conveyed hot from the dryer to the separator and the separation made while the

Table III—Estimated Cost of Electrostatic Separation

Operating 24 hr. daily, 300 days yearly	
Supervision, per hour	$0.75
Power, per kilowatt-hour	0.02
Fixed charges, 10 per cent of installed value	
Separating 5 tons hourly	
(120 tons daily — 36,000 tons yearly)	
Separating equipment, installed	$9,000.00
Fixed charges, per ton	$0.025
Power, per ton	0.012
Supervision, per ton	0.150
Repairs, supplies, maintenance, per ton.	0.007
	$0.194
Separating 25 tons hourly	
(600 tons daily — 180,000 tons yearly)	
Separating equipment, installed	$39,700.00
Fixed charges, per ton	$0.022
Power, per ton	0.006
Supervision, per ton	0.030
Repairs, supplies, maintenance, per ton.	0.007
	$0.065
Separating 50 tons hourly	
(1,200 tons daily — 360,000 tons yearly)	
Separating equipment, installed	$79,400.00
Fixed charges, per ton	$0.022
Power, per ton	0.004
Supervision, per ton	0.015
Repairs, supplies, maintenance, per ton.	0.007
	$0.048
Approximate drying and separating cost, per ton	
5 tons per hour	$0.54
25 tons per hour	0.23
50 tons per hour	0.16

material temperature ranged between 150 and 250 deg. F.

Any separation cost of course must be limited to the problem involved and the conditions under which the work is to be done. I, therefore, am only using general cost figures for drying which I consider reliable. They are given in Table II.

The costs given in Table II include the use of double-shell indirect heat dryers of high thermal efficiency and low dust loss. The installation cost, naturally, would be less for a single-shell type of dryer.

Approximate Electrostatic Separation Cost—As indicated in tests, the cost of electrostatic separation has been reduced through the discovery of the principle of reversibility, which simplifies many separations, especially where reversible minerals and other materials are involved. Furthermore, improvements in design have increased separating capacities materially. For example, with the Huff equipment the average separating capacity per linear foot of separating electrode on material crushed through 20 mesh was 250 to 300 lb. per hour. With the new Johnson process equipment, separating capacity per linear foot ranges from 650 to 1,000 lb. per hour, depending on the material separated.

Improvements in equipment design and the discovery of reversibility have entirely changed the possibilities of application of electrostatic separation, especially for larger tonnage operations as in the separation of non-metallic minerals such as cement rock and raw materials, phosphate rock and matrix, coal cleaning, and purification of sand, feldspar, fluorspar, and other raw materials used in the manufacture of glass, ceramics, and various industries.

The electrostatic separators available through the Ritter corporation for use in the mining industry require a floor space of 4x9 ft. and a height of 10 ft. Power consumption is 1 hp. Capacity ranges from 14,000 to 20,000 lb. per hour, depending on the specific gravity of the material and the type of separation required.

The largest electrical equipment furnished by the Ritter corporation for the mining installations requires a floor space 3x5 ft. Power consumption is 1.5 hp. Capacity of this unit is large enough to operate ten of the largest separators.

There are no vibrating parts or high-speed drives on any Johnson equipment. All moving parts are well protected against dust and moisture. Repair and maintenance cost is lower than that of any other separating equipment on the market. One operator easily can take care of ten separators handling from 70 to 100 tons hourly. The original adjustments never have been changed on many separators which have been in operation five years or more.

The equipment is so designed that each linear foot of separating capacity does the same work. Therefore, variations in feed are automatically taken care of and the separating efficiency and recovery are uniform and constant.

I mention these details to show why electrostatic separation is low in cost. Power consumption per ton of capacity is lower than in any other separating process, as is likewise labor and maintenance cost.

The estimated cost figures in Table III are quite representative.

ANOTHER VIEW of the electrostatic laboratory at Rochester, N. Y.

The cost of screening if necessary, elevating, and conveying the feed and separated products varies with different conditions and must be added to the drying and separating cost. Building or housing cost must also be taken into consideration.

The testing procedure determined from the new mineral list removes the uncertainty of electrostatic separation. It is possible to make reasonably close estimates on any size and type of separating equipment, and to obtain suitable guarantee covering performance.

I have been persuaded to write these articles by several of my friends interested in the general subject of milling and concentration work who felt that more up-to-date information would be helpful in the broad consideration of concentrating problems. It is my hope that presenting this historic development of the art, the improvements, discovery, and new mineral list, combined with new equipment design, will be of assistance to engineers in various parts of the world who are strugg'ing with milling and concentrating problems. I believe that the commercial application of one of the well-known basic principles of concentration, namely: the difference in surface conductivity of the particles to be separated—will be broadened by the reversibility selective polarity control.

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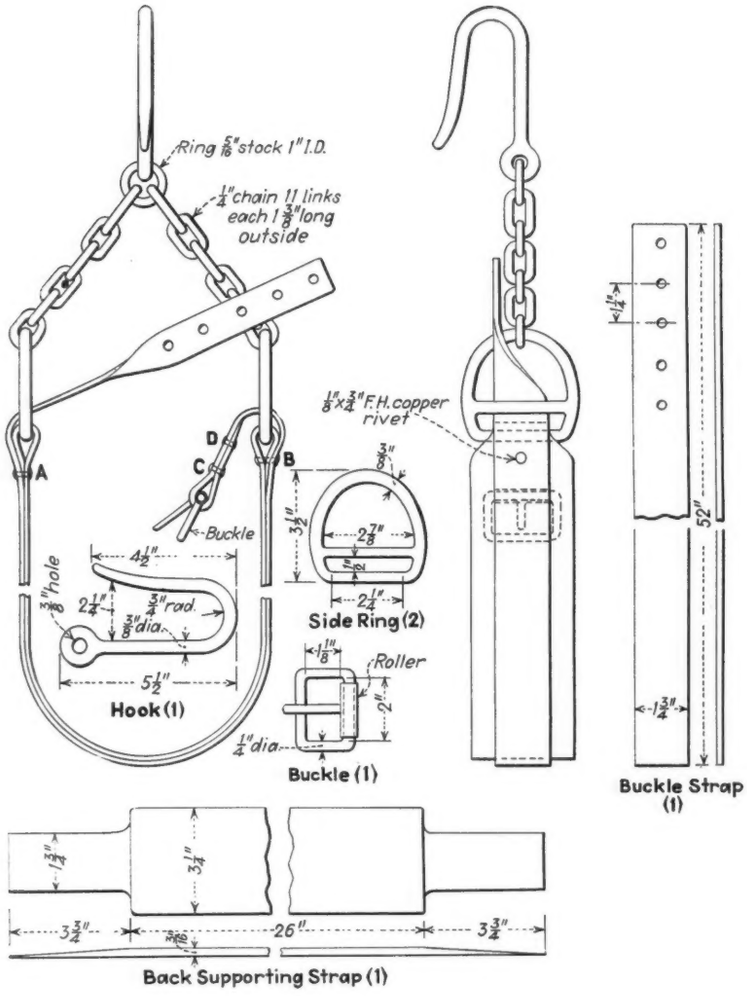
Tin in Tanganyika

DISCOVERY of cassiterite in the Kagera district of Tanganyika in 1924 resulted in a production of 172 tons of concentrate by the end of 1930, this on the site of the original find at Kyerwa, according to the report of the Territory's Geological Division. In 1929 a subsidiary of the Dutch Billiton interests had begun systematic exploration but withdrew in 1931, without important discovery, the price of tin ore meanwhile having dropped as low as $135 per ton. Save for the Kyerwa area, the region was thereupon released for general prospecting. In 1933 the Kyerwa area passed into the hands of Kagera (Uganda) Tenfields, Ltd., excepting the original discovery, which remained in a tributer's hands. Regular output has been maintained by the Kagera company from detrital ground and the rest of the concession is being prospected.

Since 1932, the price of tin has risen slowly, and small residual deposits remaining in the hands of uncapitalized individuals have yielded a rising production. Total output of tin ore from the Karagwe fields at the close of 1936 was 933 tons of concentrates. All the granite intrusions in Karagwe are already known, so that the discovery of entirely new fields cannot be anticipated, but rich pockets are continually being found.



Safety Belt for Use in Braking Cars

AFTER ORE CARS have been loaded with concentrates at the washing plants on the Mesabi range in Minnesota it is necessary to store them on a siding until there is a sufficient number of them to be taken out by locomotive to the main line, writes L. C. Moore, of Hibbing, Minn. This storage track, sometimes a half-mile long, is graded away from the plant with sufficient incline for the cars in strings of three to roll down by gravity with a brakeman riding them and controlling their speed by the hand brake wheel. When the brakeman stops the cars in the yard, he sets the brakes, then returns to the plant for more cars to lower.

In cold, wet, slippery, or snowy weather this braking job becomes dangerous, and several fatal accidents have occurred. To eliminate this hazard a large variety of safety belts have been tried out. The most successful one that overcomes operating objections was developed by J. A. Wivel, foreman of the Canisteo washing plant. It is shown in the sketch.

The side rings, hook, and hook ring were made by the mine blacksmith, who also welded the $\frac{1}{4}$-in. 3 B chain, hook, and side rings into one assembly. The belt was then completed by the local shoemaker, who tapered down the ends, looped them back, and sewed the belts together with heavy thread along the dotted lines one-quarter inch from the edge of belt. The 2-in. iron buckle was supplied from the shoemaker's stock. He also added No. 6 copper belt rivets at points *A*, *B*, *C*, and *D*, with a leather belt loop between *C* and *D*.

Equipped with this belt, a brakeman climbs to the braking position on the car, slips the hook around the brake post, and leans back in the belt, which allows him sufficient room to use his brake stick with full leverage. If he slips and falls, the belt will catch and hold him from falling beneath the wheels. No accidents have occurred since this design was adopted.

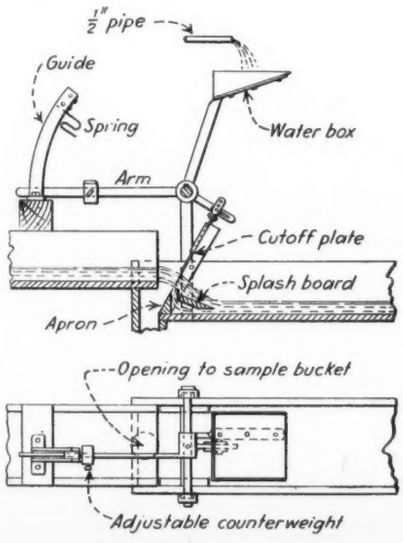
The belts can be made for a cost not exceeding $8 each. They are light and easily manipulated and the brakemen make no objections to wearing them.

A Water-operated Pulp Sampler

AT A MEXICAN cyanide plant situated in a remote region where only unskilled labor is available for plant operation, the superintendent was recently confronted with the problem of providing an automatic sampler for the mill tailings launder. To meet conditions, the contrivance had to be of simple design, so as to make possible its construction at the blacksmith shop; easy to install, and reliable. The unit explained in the accompanying sketch has more than met these requirements.

As will be seen, the pulp passes from the upper launder to the lower launder, and at predetermined intervals the cut-off plate or gate descends and deflects the stream into the sample opening. The descent of the gate is governed by a water box fed from a small water pipe, which, when full, falls to the right and empties itself. After this has occurred, the counterweight restores the box to its original position. The interval between successive falls of the box can be regulated by the rate of flow of water into it, and the length of time it is down can be adjusted by varying the rate of discharge from the box.

To prevent any pulp that works back from entering the sample opening, and splashing, the lower launder is provided with a wooden apron and a splashboard, both extending across the full width of the launder. The gate operates in slides, and the force of the pulp presses it upon them so that no part of the current can escape into the lower launder while it is down. In this manner a true sample is obtained, which is an important feature of the design.



Silver Producers' Research Directed to Coatings

As Offering Best Opportunity for Tonnage Use —Other Investigations Not Neglected

THE great immediate opportunity to develop a tonnage use for silver lies in the field of coatings. This has become increasingly clear as work has progressed in the National Bureau of Standards on the American Silver Producers' Research Project, the seventh and last progress report appearing under date of Nov. 1, 1938. In consequence all other lines of attack are being subordinated to this one, but not to their exclusion. Funds which have been held in reserve are now being applied to speeding up this part of the program.

Problems included in the program are as follows, in the approximate order of their presumed importance:

A. *Coatings:* (1) 0.0001 in.; cans. (2) 0.001 in.; barrels and special containers. (3) 0.02 in.; bearings. (4) 0.02 in. and up; tanks.

B. *Alloys*: (1) Silver-poor. (2) Silver-rich.

C. *Contacts*: (1) Sliding. (2) Bonded.

D. *Miscellaneous*: (1) Fungicides and bactericides. (2) Miscellaneous.

Coatings—Cans: Factors which have caused coatings to be regarded as the most probable solution to the problem of extending the industrial use of silver are: (a) tonnage possibilities; (b) the great room for improvement in present tin and lacquer coatings; (c) the cooperation received from the industries involved; (d) the experimental progress made toward producing very thin adherent non-porous coatings of silver on steel. Claim is not made that all the problems involved have yet been solved but skepticism has changed to confidence.

The original aim as to tonnage, under the Project, was to find new or expanded industrial uses for 100,000,000 oz. of silver a year. The International Tin Research and Development Council gives the production of cans of all types in the United States alone as 12,000,000,000 a year and the cost of the usual packing can as 2c., with an admittedly porous tin coating 0.00008 in. thick accounting for about 8 per cent of the total. The present objective is to replace the tin with 1 to 3c. worth of silver, which however will but double the cost approximately of the can, although silver costs at present twelve times as much per pound as tin. At 2c. a can, roughly one-twentieth of an ounce of silver at the present market, it will be necessary to occupy but one-sixth of the can market to absorb the entire silver quota. This permits selection of the most vulnerable part of the field which will presumably pay twice as much for a better can—and such a field does exist—or attacking the larger territory on the basis of recovery of silver in the scrap.

As to the vulnerable points in the present tin can, these are lack of ductility, causing in some cases complete abandonment of tin in favor of lacquer where severe forming operations are necessary; excessive porosity affecting the flavor of many products; and direct solvent action on tin by some products. These defects are being studied by the very competent tin research group, and improvement may result, but at present the attack is still valid and there is no simple remedy where fine points of flavor are involved. Lacquer coatings are open to similar criticism except that they can be applied to the can after forming.

As to cooperation, the beer industry has been taken as a suitable field in which to make the first attack, and cordial help is being given by can manufacturers, barrel makers, and brewers. Some brewers are going to great pains to brew a fine flavor, and silver is the ideal material for storage. The United States produces about one-third of the world's 186,000,000 bbl. of beer, and last year marketed about 7,300,000,000 12-oz. bottles and 700,000,000 12-oz. cans.

Finally, as to experimental progress, the interest of those engaged in the research was originally taken up with the so-called "clad" metals rolled from a large duplex ingot. This appears to be an excellent method for relatively thick coatings, especially for chemical ware, and some beautiful cans have been made with 0.001 in. silver on either steel or copper. Such a product may have a definite market for handling essential oils, certain chemicals, and the like, where the content is valuable, but is evidently not a competitor with tin. Naturally there is a limit as to the extent to which a duplex ingot can be rolled without producing bald spots. We know of contact material so produced having a silver thickness of 0.0005 in., but even if a non-porous 0.0001 in. thickness is attainable, it is obviously an expensive way of arriving at the result as compared with building up the coating by electrolysis or otherwise. After the container situation was fully understood, additional work on electrolytic coatings was undertaken under the direction of Dr. William Blum at the Bureau of Standards, and finally all conceivable coating methods were listed for examination somewhat as follows:

(*a*) Clad metal rolled from duplex ingot. (*b*) Clad metals made by hot dipping. (*c*) Spraying. (*d*) Chemical reduction on metallic base. (*e*) Chemical reduction on non-metallic base. (*f*) Electroplating with or without "strikes" of other metals. (*g*) Electroplating followed by rolling. (*h*) Brush plating. (*i*) Turbulence plating.

These various methods are being considered as applied to deep-drawing steel sheet and also to the formed can and the criteria are cost and freedom from porosity.

Although silver plating is about 100 years old, little work has been done on porosity, as it has been used almost entirely for ornamental purposes. In the researchers' first attempts at getting a perfectly non-porous electroplate of silver on steel it proved necessary to put on 0.002 in. before the last pores disappeared, but experience is rapidly cutting this down. Using "brush" plating, a perfect coating 0.0002 in. thick was obtained and this likewise is being cut. To date it appears that the mechanical action introduced by the brush is most effective at the moment of plating. In other words, burnishing during or after plat-

ing may not be the answer. The possibilities of hydraulic action, or "turbulence plating," are therefore being studied.

As mirrors of a thickness in the millionths of an inch can be uniformly made, studies are under way to ascertain how much they have to be built up to avoid porosity. It would be a nice solution if a mirror could be chemically deposited on a lacquered can, the usual optical requirements being unnecessary.

It is because the tonnage possibilities are so large, because so many avenues of approach are available and so little is known about porosity control and because rapid progress is being made in the experiments, that the researchers feel justified in concentrating on the problem of making a commercially thin silver coating on steel.

Coatings—Barrels: There is a lesser but still large tonnage possibility in barrels. Using a heavy outer steel shell with an inner container of either steel or copper, sheet silver appears to be commercial if the cost of coating exclusive of the value of the silver is low enough. A consumption of 5,000,000 oz. a year might be realized, but after some years there would be a scrap return.

Coatings—Bearings: The silver-bearing situation is hard to appraise. The work sponsored at Battelle Memorial Institute verifies that silver stands preeminent as a load-carrying material and its ductility, conductivity, and other physical properties all contribute to its superiority. Its puzzling, somewhat uneven, performance in service appear due either to resistance to wetting by oil or to grit, encountered in service in practice. Lead coatings have seemed beneficial in service, and Battelle has been experimenting with the properties of silver-lead alloys and the preparation of such bearings by electrodeposition. The facts that the airplane builder does not make the bearings, that the business is highly competitive and under rapid growth, that there has been neither time nor adequate equipment available for basic research by those most interested, that service conditions are hard to duplicate in the laboratory, and that much of the use is of a military nature, combine to make it difficult for an outsider to be useful.

In general, silver bearings seem here to stay and are in wider use than is publicized. The demand for better bearing materials is spreading into the diesel and other fields. It is not yet possible to present figures that indicate any very substantial tonnage in this direction, however.

Coatings—Tanks: Makers of silver-clad iron, copper, and nickel are now actively exploiting this field, and those engaged on the research project have, for the moment at least, turned their efforts toward the development of the thinner coatings previously discussed. A series of corrosion tests comparing fine silver with the present material of construction used in suitable industries had been sketched but was laid aside for the immediate corrosion problems in the beer industry.

Alloys—Silver Poor: As more complete physical data are secured, encouraging improvement in properties due to silver additions begin to emerge. In some of the brasses and bronzes, surprising increases in strength without loss of ductility are obtainable with additions of 1 to 5 per cent of silver. An added cost of 6 to 30c. a pound is not necessarily prohibitive in expensive bronzes.

Magnesium Plus Silver—One Alloy Commercial

Silver additions to magnesium are interesting. Preparation of magnesium alloys and extruded shapes is not easy, and this field was given up with the understanding that the principal producers would do active work with silver. It has already been reported that a certain alloy containing 5 per cent silver will be commercialized, and data are available showing that 2.5 per cent silver greatly improved an alloy of the AM265 type, the heat-treated cast bars combining high-yield strength with good ductilities and without loss of corrosion resistance.

As for the lead-silver alloys, storage-battery experiments in progress for many months show that the addition of 0.1 per cent silver to the regular antimonial lead plates causes substantial increase in anodic corrosion resistance without objectionable effects in other directions. Various types of batteries so equipped are to be given service tests. This alone may mean an annual consumption of 750,000 oz. of new silver in the United States.

Solders to date are disappointing. Lead-silver solders have their place when subjected to heat and vibration, but it has not been found possible to displace lead-tin solders from their present field by lead-silver or lead-tin-silver combinations.

Iron-silver alloys are creating interest, on the practical as well as the theoretical side. One government laboratory has virtually suppressed gas inclusions in rimmed iron by addition of small amounts of silver, and the objectionable residues left by metallic deoxiders are absent. A large steel company is examining this.

Alloys—Silver Rich: The outstanding member of this group is silver-silicon. Additions of silicon up to 1.5 per cent greatly harden silver without impairing its resistance to chemical corrosion. At least three groups have worked on this in the past, the alloy has been put to certain private uses and some patents are outstanding, but its properties have not been a matter of common knowledge. Just how far its use may go depends somewhat on the extent to which silver-clad metals will occupy the field.

Contacts—Sliding: Work on this program has been recast to bring it more in line with facts. The whole question of current collection has been discussed with the principal manufacturers of brushes and of electrical machinery. The views of both may be grouped as belonging to, first, those who believe in leaving well enough alone and see little application for silver due to its cost, and second, those who have already had some experience with silver and hesitate to say what the limitations are.

To an outsider the whole subject looks odd. Catalogs list a hundred or so different types of brushes, and it appears needful to fill in an elaborate questionnaire before the suitable brush can be chosen. A long list of brush diseases is appended, with treatments for various symptoms. Admittedly rotary converters and reversible railway motors behave badly under the best circumstances. Humidity and various factory atmospheres disturb performance. Finally, the magnetic circuit seems to be designed for the benefit of the brushes.

Two general types of brush are in use, the carbon and the copper-graphite. The former ranges through many degrees of hardness and with graduated additions of abrasive. The latter contains about 90 per cent copper as a rule and is used in alternating-current work and in a limited field of low-voltage direct-current operations. The yearly brush consumption runs into millions.

To the researchers engaged on the Project the situation looks vulnerable. In the last five years silver contacts have been installed in most heavy-current switchgear, because though copper starts cool it does not stay so, because of the poorly conducting films of copper oxide which form; whereas silver, if it tarnishes at all, forms the relatively conducting silver sulphide and the switch can be rated for continuous service at its starting capacity. In sliding contacts such as commutators the same argument should hold. At present, commutators are made oversize to allow for truing up and the intentionally abrasive action of brushes, but oxidation still occurs and copper dust gets in places electrically undesirable. With silver to silver these particular difficulties vanish and, as one finds that under certain conditions a silver-graphite brush throws a silver film on opposing copper, only the brush need be changed.

The researchers have in mind certain definite aims. These are first to ascertain under what conditions this silver film is thrown; second, to secure figures for brush wear at various pressures and current densities; and third, to repeat the work in a highly humid

atmosphere. A silver-graphite brush will be used against a copper-graphite control. Electrical losses and temperatures will be measured.

It is hoped that the results will indicate sufficient superiority to warrant substitution of a silver-graphite-*faced* brush where copper-graphite is now used, and indicate possible current-density ratings which will justify refinement in design of the magnetic circuit to enable the metallic brush to encroach further on the field now occupied by carbon. Near-elimination of the heat developed at the commutator would increase ratings, and in fact long dormant schemes for use of iron commutators and even revolving brushes might be revived. In any case there is little to be lost by trying.

Contacts—Bonded: Work at Lehigh on the time-pressure-temperature relationship in the "cold" welding of silver has yielded interesting results. Definite curves have been established between any two variables, the third being held constant. The temperature of 200 deg. C. appears to be the lowest at which good adherence may be obtained without inordinate pressure and time. Curiously, grease on the surfaces had little effect. A rubbing together is more effective than static pressure. The Research Project has been led to try some new experiments using proof silver. This work is aimed at finding a method of making cold brazes on the one hand and how to avoid the sticking of silver contacts on the other. The data obtained are provocative to further thought.

Miscellaneous: On fungicides and bactericides a most interesting report from Cornell is submitted. Preliminary experiments on fish indicated promising control of many of their troublesome diseases, but the tonnage prospects were not sufficient to justify further expenditures on behalf of the Project in that direction.

In agriculture the Project workers have narrowed the field to protective plant sprays and are endeavoring to displace "Bordeaux" copper with silver as (a) less expensive in general, (b) more toxic to certain organisms, (c) less toxic to certain plants, (d) less defacing to "ornamentals," and (e) less objectionable in accidental soil accumulations. Encouraging results are obtained in all these directions.

In the field of bacteriology various independent clinical workers continue to show interest and some work is being done on chewing gum as a medium of administration. Reorganization of the Katadyn interests is making some progress and the silver sand portable filters are developing good sales. The necessary silver sand is now available as an American product. The doubtful tonnage factor has limited the expenditures in this field.

An interesting new use for silver is its addition to the glass used in some new types of lamps. Action of the ultra-violet rays is to cause fluorescence of such a character that the blend of visible wave-lengths emitted gives the desired white light. Whether silver can be replaced by something cheaper yet remains to be determined.

Silver as a component of anti-fouling paint for ships' bottoms is being looked into by the appropriate division of the Navy. Extreme pressure lubricant in which silver sulphide has been incorporated is under test. The silver plating of electro-copper foil suitable for cap linings seems to be successful. Preliminary reports on silver additions to copper welding rods are entirely favorable.

Leveling Underground

WHEN it is desired to run a line of levels over underground stations that are in the back or roof, it is customary to hold the rod upside down on the spads. It is difficult to plumb the rod and illuminate and manipulate the target while keeping contact with the spad. The work is simplified by hanging the rod from the spad, says Walter S. Weeks, professor of mining, University of California, Berkeley, Calif.

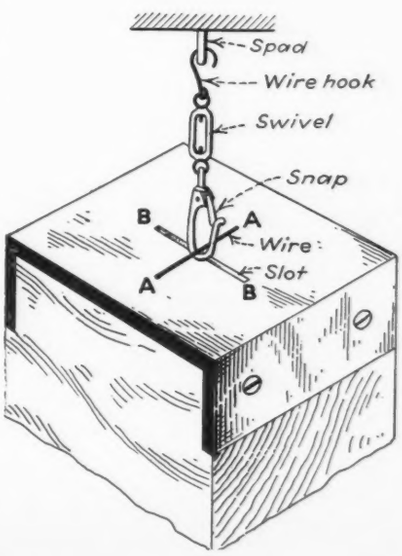
This may be done in the following manner without destroying the rod for use on the ground: Remove the brass base plate of the rod and mill two slots, at right angles to each other and intersecting in the exact center of the plate. The slots should each be 1 in. long. One slot is 0.05 in. deep and 0.05 in. wide and the other is 0.10 in. deep and 0.05 in. wide. The deeper one may go clear through the plate if necessary.

In the shallower slot solder a piece of hard steel wire 0.05 in. diameter to fill the slot. Fill in around the wire with solder and smooth it off to be flush with the surface of the plate.

At a sporting goods store obtain a swivel and snap such as is used to hold a sinker or casting plug. At the end of the swivel away from the snap, fashion a wire hook to engage the spad.

By means of the slot *BB,* in the illustration, the wire of the snap may be slipped under the wire soldered in the plate, and the rod may then be hung from the spad and turned in azimuth by means of the swivel. If a light is hung on the target, the chain man has both hands free to manipulate the target. The light must not be heavy enough to cause the rod to hang out of plumb appreciably.

In taking levels between two spads no attention need be paid to the suspension device, because, if its length were considered, it would cancel out. If, however, one station were on the ground and one in the back, it would be necessary to consider the suspension.



When the snap is removed from the rod, the change made in the base in no way interferes with the use of the rod on ground stations.

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Save the Diamonds!

LOSS OF DIAMONDS from diamond drill reaming shells is frequent when drills are pulled in caving ground without revolving. This loss has been practically eliminated by a recent development by United States Bureau of Reclamation engineers at Grand Coulee dam. They have also tripled the life of the shell.

Ordinarily, the diamonds are set in the lower periphery of the mild steel shell. Rapid wear of the latter leaves the diamonds high and consequently more easily knocked out of the mounting. The new method is to take the ordinary shell and bore a number of $\frac{1}{8}$-in. holes around in the mounting site to a depth of about $\frac{1}{8}$ in. With a good tungsten-carbide alloy, inserts are brazed into these holes, building the metal up somewhat higher than the diamonds will come. Then the shell is put in a lathe and the piled-up metal ground down to gage with a grinding wheel. Finally, the diamonds are set to gage in the valleys between the inserts.

The insert metal wears down somewhat faster than the diamonds, so that the latter function at all times, but their settings are always protected.

Open-Pit Transport On the Mesabi Range

III

Steam Haulage Versus Electric Haulage —continued

L. C. Moore
Mechanical Engineer
Hibbing, Minn.

CONDITIONS cited in Part II of this discussion, published in November, led to the selection of a 4-car train and a 65-ton locomotive as being most suited to the conditions governing the transport problem tabulated on page 52 of the November number. Train weight data were presented in Table III. Table IV, below, shows details of locomotive cycles from various assumed shovel locations based on the use of 65-ton locomotives and 4-car trains.

Table VI shows combined capacity of shovels and locomotives in ore haulage, based on the use of a 4-car train. When shovels are at present elevations of 580 to 600 ft., it is found that three 4-car trains and one shovel will produce the required average output of 4,375 long tons, with locomotive waiting time varying from 7 to 13.3 min. This is shown in item (q) of Table VI. The maximum output of 5,000 long tons can be produced by three 4-car trains and two shovels as shown in item (r), but with 0.0 min. locomotive waiting time. From this it might be concluded that only three locomotives would be required. There are, however, two reasons why a fourth locomotive should be considered; first, a general utility locomotive which can also be used as a spare as occasion demands, is quite desirable, and second, as the pit grows deeper and time of run becomes longer, another locomotive is required to serve the shovels. It is, therefore, considered advisable to include this additional locomotive at the outset. The cost of installation therefore includes four 65-ton locomotives.

When four 4-car trains are used to serve two shovels at present levels, a maximum day of 5,000 long tons will be produced as shown in item (u) of Table VI in which the locomotive waiting time varies from 19.6 to 25.9 min. per trip. This provides considerable margin for operation as the pit becomes deeper.

It is estimated that when the shovels are at the ultimate bottom level of the pit, elevation 460, the locomotive cycle including locomotive running time, loading time, and dumping time, will be approximately 84 min. Under this condition, as shown in items (w) and (x) of Table VI, four locomotives serving one shovel will produce the average day output with 12 min. locomotive waiting time, and when serving two shovels will produce 5,030 long tons in 8 hours, which is slightly more than the required maximum of 5,000 long tons. It would seem, therefore, that four 65-ton locomotives will serve this mine successfully until the end of its life, twelve years hence.

There is no particular problem involved in hauling 500,000 cu.yd. of stripping. On account of the lighter weight of stripping per car, it is possible to use 5-car trains. The performance of the locomotives under this condition is shown in Tables V and VI-A.

Steam locomotives used in the past weigh 67 tons on drivers and have a tender weight of 51 tons. The rated

Table IV—Time Cycle and Power Consumption From Shovel Location No. 1 on 583-ft. Level

4-car train; ore per train, 220 long tons; train weight, 427 tons (2,000 lb.) 65-ton locomotive

From	To	Distance in Feet	Elevation Difference in Feet	Average Curve, Degrees	Average Grade %	Average T. E. Lb.1Ton	Average Locomotive T. E. Lb.	Control Position	Time of Run in Minutes	Locomotive, Amperes	Kw. Hr. for Traction DC Bus
Shovel	F	350	0	0	0	8	3,410	Par.	0.60	240	1.8
F	E	450	12	10	2.66	69.2	29,600	Ser.	1.65	500	10.3
E	D	300	5	13.3	1.60	50.6	21,600	Par.	0.75	785	7.4
D	C	850	20	12.3	2.36	65.0	27,700	Ser.	2.55	475	15.1
C	B	1,850	18	4.9	0.98	31.5	13,500	Par.	2.05	560	14.3
B	Crusher	18,950	202	2.4	1.06	31.1	13,300	Par.	17.50	550	120.5
Shovel	Crusher	22,750	257	3.3	1.13	....	.....	....	25.10	....	169.4
Increase time of run for 4 switchbacks									1.00		
Increase kw. hr. for air compressor operation											10.0
Increase kw. hr. 5% for downhill running, spotting, etc											9
Total time shovel to crusher									26.10 minutes		
Total kw. hr. at substation DC Bus per round trip											188.4

Locomotive Cycle	Minutes
Shovel to crusher	26.1
Dumping 4 cars	4.0
Returning to shovel at 20 m.p.h. average	12.9
Loading 4 cars	20.0
Total locomotive cycle exclusive of waiting time	63.0

Shovel Cycle	Minutes
Loading 4 cars	20
Shovel waiting time	4
Total shovel cycle	24

	Minutes
Required time of locomotive duty cycle when shovel is served by three locomotives (= 3 × 24 min.)	72
Total locomotive cycle exclusive of waiting time	63
Locomotive waiting time basis 3 locomotives serving shovel	9

Table V—Time Cycle and Power Consumption in Stripping

Shovel at 760-ft. elev. to dump at 840-ft. elev.; 5-car train; 156 cu yd. stripping per train; total train weight, 428 tons; 65-ton locomotive

From	To	Distance in Feet	Elevation Difference in Feet	Average Curve, Degrees	Average Grade, %	Average T. E. Lb.1Ton	Average Locomotive T. E. Lb.	Control Position	Time of Run in Minutes	Locomotive Amperes	Kw. Hr. for Traction DC Bus
Shovel	A	6,000	−44	2.5	−.73	−2.6		Off	4.5	0	0
A	Dump	11,000	124	2.5	1.13	34.6	14,800	Par.	10.6	600	79.6
Shovel	Dump	17,000	80	2.5	....	....	.....	....	15.1	....	79.6
				Return Trip with 5-Car Empty Train Weighing 210 Tons							
Dump	A	11,000	—124	2.5	—1.13	—10.6	.....	Off	6.3	0	0
A	Shovel	6,000	44	2.5	0.73	26.6	5,600	Par.	4.7	320	18.8
Dump	Shovel	17,000	−80	2.5	....	....	.....	....	11.0	....	18.8

	Kw. hr.
Increase kw. hr. for air compressor operation	10
	108.4
Increase kw. hr. 5% for spotting and miscellaneous	5.6
Total kw. hr. at substation DC bus per round trip	114.0

Locomotive Cycle	Minutes	Shovel Cycle	Minutes
Shovel to dump	15.1	Loading 5 cars	25.0
Dumping 5 cars	5.0	Shovel waiting time	4
Returning to shovel	11.0		
Loading 5 cars	25.0	Total shovel cycle	29.0
Total locomotive cycle exclusive of waiting time	56.1		

	Minutes
Required time of locomotive duty cycle when shovel is served by three locomotives (= 3 × 29 min.)	87
Total locomotive cycle exclusive of waiting time	56.1
Locomotive waiting time basis 3 locomotives serving shovel	31.9

tractive force is 28,200 lb. at 180 lb. per square inch steam pressure. These locomotives were used to haul 4-car trains. Four new steam locomotives duplicating the foregoing figures are being considered if steam operation is again restorted to.

It should be observed that the electric locomotive proposed for this application has superior operating characteristics, particularly at the lower speeds. At starting, the electric locomotive will give 39,000 lb. tractive effort at 30 per cent adhesion, whereas the steam has a maximum of 28,200 lb. Therefore, the electric will start a heavier load and will be less liable to stall on heavy grades. The steamer has the dead weight of tender to drag around and this either reduces the amount of useful trailing load which can be hauled, or reduces the margin against slipping of drivers. In the comparison of train weights in Table III, items (j) and (u) indicate that for the same trailing load the steamer has 7.5 tons total train weight per ton on drivers, whereas the electric has only 6.6. It is concluded that the electric locomotive provides a margin of $(7.5\text{-}6.6) \div 6.6 = 0.136$, or 13.6 per cent against slipping as compared with the steam locomotive.

The electric locomotive will show greater tractive effort than the steam locomotive at all speeds from 0 m.p.h. to approximately 11 m.p.h. and the operation of the electric locomotive will therefore be faster than the steam on the steeper grades. This will be offset somewhat by the greater speed of the steamer on level track and light

Table VI—Combined Capacity of Shovels and Locomotives in Ore Haulage

(a)	Total long tons of crude ore in season	1,050,000
(b)	Total number of working days in ore season	120
(c)	Total number of 8-hr. shifts in ore season	240
(d)	Average long tons ore per 8-hour shift (a÷c)	4,375
(e)	Maximum required long tons of ore per 8-hr. shift	5,000
(f)	Capacity of 30 cu. yd. car, long tons	55
(g)	Capacity of 4-car train, long tons (4xf)	220
(h)	Shovel time for 4-car train is 20 min. for loading 4 cars, and 4 min. waiting; total, min.	24
(i)	Loading capacity of shovel in long tons per 8-hr. shift, (g÷h) x 480	4,400
(j)	Number of shovels required for ave. shift of 4.375 long tons	1
(k)	Number of shovels required for max. shift of 5,000 long tons	2

		No. 1	No. 2	No. 3	No. 4
(l)	Typical shovel location, Fig. 1 at elevation.	583	584	601	604
(m)	Shovel cycle in minutes (for 220 long tons) including 4-minute waiting time	24	24	24	24
(n)	Loco. cycle exclusive of waiting time, min.	63	65	58.7	60.4
(o)	Capacity of one shovel, long tons in 8 hours	4,400	4,400	4,400	4,400
(p)	Capacity of two shovels, long tons in 8 hours	8,800	8,800	8,800	8,800
(q)	Combined capacity, 3 locomotives serving one shovel				
	Long tons ore in 8 hours	4,400	4,400	4,400	4,400
	Shovel waiting time, min.	4	4	4	4
	Locomotive waiting time, min.	9	7	13.3	11.6
(r)	Combined capacity, 3 locomotives serving two shovels				
	Long tons ore in 8 hours	5,040	4,870	5,400	5,250
	Shovel waiting time, min.	22	23.3	19.1	20.3
	Locomotive waiting time, min.	0	0	0	0

		No. 1	No. 2	No. 3	No. 4
(s)	Combined capacity, 4 locomotives serving one shovel				
	Long tons ore in 8 hours	4,400	4,400	4,400	4,400
	Shovel waiting time, min	4	4	4	4
	Locomotive waiting time, min.	33	31	37.3	35.6
(t)	Combined capacity, 4 locomotives serving two shovels				
	Long tons ore in 8 hours	6,700	6,500	7,200	7,000
	Shovel waiting time, min.	11.5	12.5	9.4	10.2
	Locomotive waiting time, min.	0	0	0	0
(u)	Performance of 4 locomotives and two shovels in producing a maximum of 5,000 long tons				
	Long tons ore in 8 hours	5,000	5,000	5,000	5,000
	Shovel waiting time min.	22.3	22.3	22.3	22.3
	Locomotive waiting time, min.	21.6	19.6	25.9	24.2

Estimated Performance When Shovels Are at Ultimate Bottom of Pit at 460-ft. Elevation. Approximate Locomotive Cycle Exclusive of Waiting Time 84 Minutes

(v)	Combined capacity, 3 locomotives serving one shovel	
	Long tons ore in 8 hours	3,770
	Shovel waiting time, min.	8
	Locomotive waiting time, min.	0
(w)	Combined capacity, 4 locomotives serving one shovel	
	Long tons ore in 8 hours	4,400
	Shovel waiting time, min.	4
	Locomotive waiting time, min.	12
(x)	Combined capacity, 4 locomotives serving two shovels	
	Long tons ore in 8 hours	5,030
	Shovel waiting time, min.	22
	Locomotive waiting time, min.	0

Table VI-A—Capacity of Shovels and Locomotives in Stripping (5-Car Trains)

(a)	Total yards of stripping in season	500,000
(b)	Total working days in stripping season	80
(c)	Total number of 8-hour shifts in stripping season	160
(d)	Average cu.yd. stripping per 8-hour shift (a ÷ c)	3,125
(e)	Capacity of 30-cu.yd. car in cubic yards (assumed)	31.2
(f)	Capacity of 5-car train in cubic yards	156
(g)	Shovel time for 5-car train is 25 min. loading and 4 min. waiting time ÷ total, min.	29
(h)	Loading capacity of shovels in cubic yards per 8-hour shift (f ÷ g) x 480	2,580
(i)	Number of shovels required for average shift of 3,125 cu. yd.	2
(j)	Shovel cycle in min. (for 156 yd.) including 4 min. waiting time	29
(k)	Locomotive cycle exclusive of waiting time, min.	56.1
(l)	Capacity of one shovel, yards in 8 hours	2,580
(m)	Capacity of two shovels, yards in 8 hours	5,160

(n) Combined capacity of locomotives and shovels

Number of Locomotives	Number of Shovels	Loco. Waiting Time Min.	Shovel Waiting Time Min.	Yards in 8 Hours
3	1	30.9	4	2,580
3	2	....	12.6	4,000
2	1	1.9	4	2,580
4	2	1.9	4	5,160

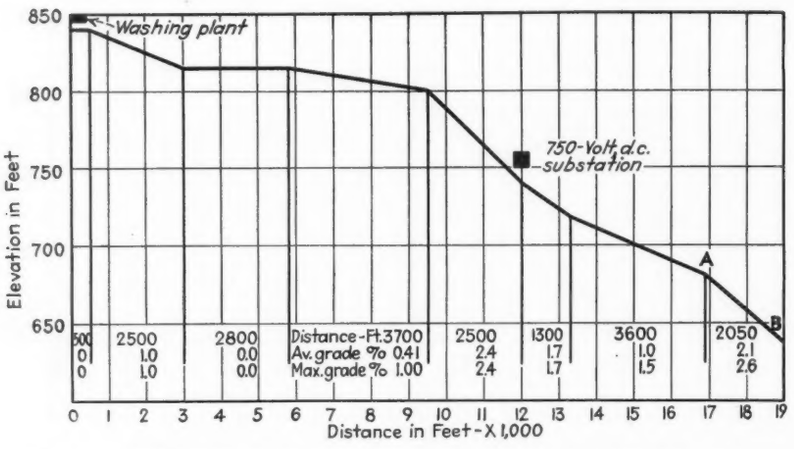
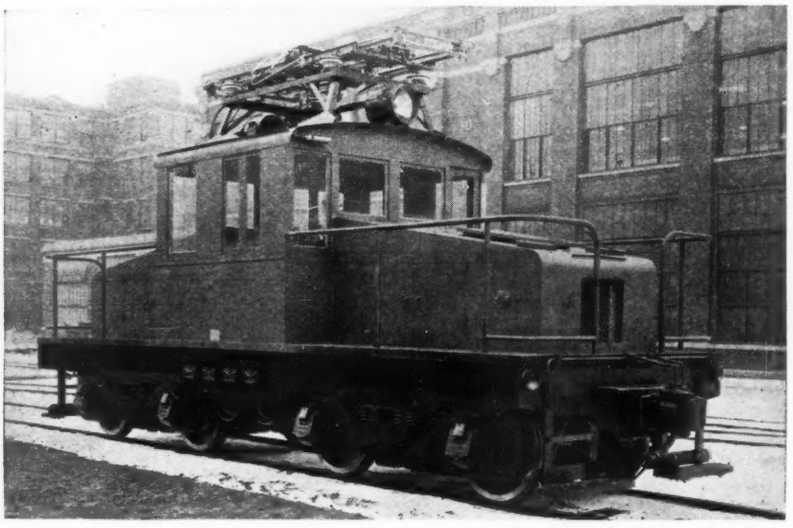


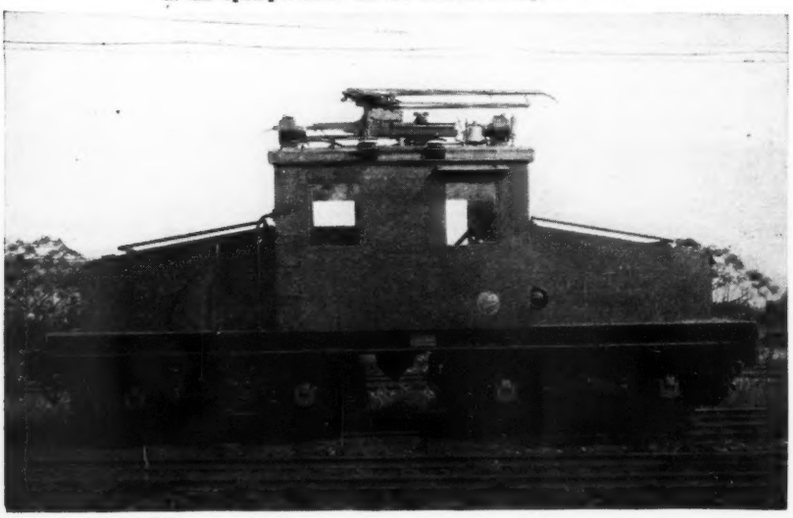
Fig. 3 . . . CONDENSED PROFILE of the open pit. The line runs from the washing plant to the first switchback in the pit at point B, shown in Fig. 2, in Part II

grades. However, as the pit becomes deeper, and as the proportion of trackage on steep grades becomes greater, the operating characteristics of the steamer will show up more adversely and it is quite probable that an additional, or fifth, steamer may be needed before the pit is exhausted.



A 65-TON ELECTRIC LOCOMOTIVE built in 1936. The proposed locomotives dealt with in the accompanying analysis are like this save for the substitution of side-arm collectors, shown in the accompanying photograph, in place of the center pantograph type

A TYPICAL LOCOMOTIVE equipped with side-arm collectors. This unit was installed at an open-pit mine on the Mesabi Range in 1928



Advice from a mine official indicates that the new steam locomotive will cost $40,000. Although this price seems high it agrees with present-day information received from another source and is, therefore, used in the estimate. Four steam locomotives are included at $40,000 each, or $160,000.

The four electric locomotives are estimated at $128,000 f.o.b. Erie, Pa. Freight charges will be approximately $2,000, making a total cost of four locomotives, delivered, $130,000.

Cost of power and of power distribution will be discussed in detail in Part IV next month. It will be recalled that at the outset of this comparison of the respective costs of steam and electric haulage, it was stated that the analysis would show a positive saving of 6.58c. per ton of concentrate in favor of electric haulage for the conditions tabulated on page 52 of the November issue. The amount of electric power required for haulage for the runs from the various shovel locations has already been presented in Tables I to V inclusive. Subsequent calculations will start from this point.

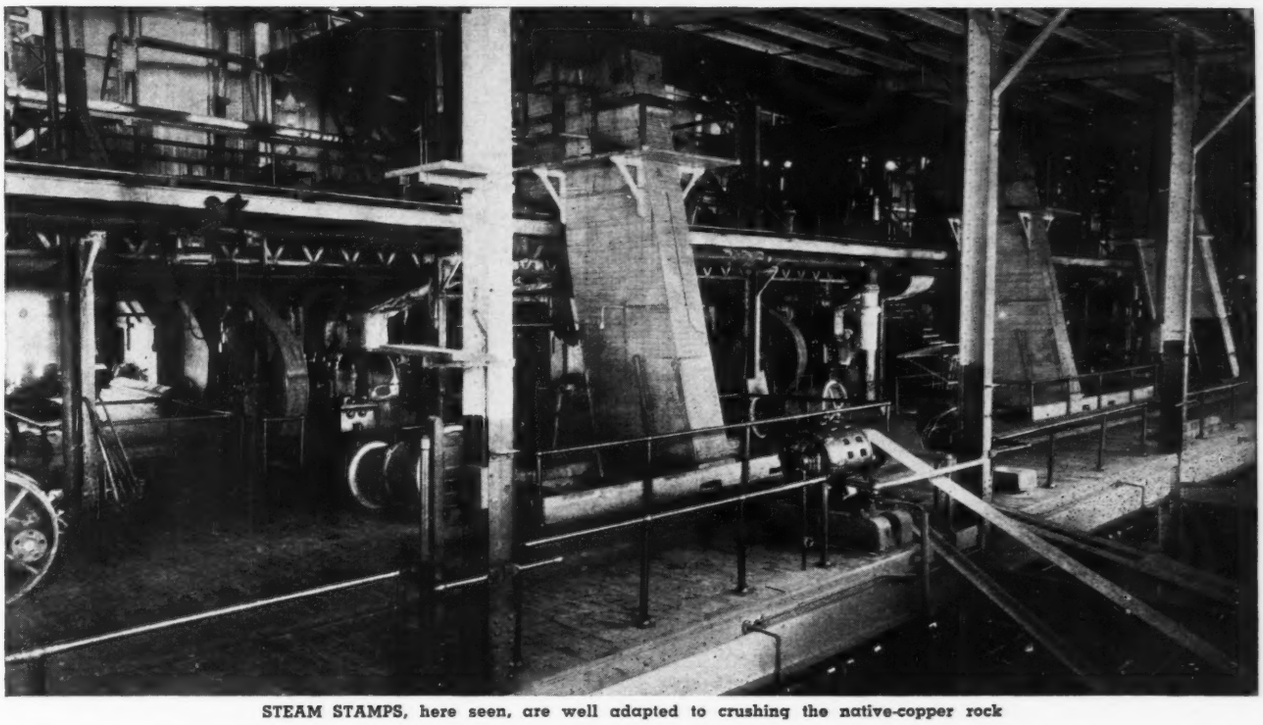
(To be continued)

▼ ▼ ▼

Recent Work of the Geological Survey

INCREASING ATTENTION during the 1938 fiscal year has been given to chemical mineralogy, with special consideration of the internal structure of minerals, according to the recent annual report of Dr. W. C. Mendenhall, Director of the United States Geological Survey. It is now possible to show that the physical properties of a mineral depend not only on the kinds of atoms composing it, but also on their rôle and arrangement in the crystal—features that can be determined by X-rays. The densities of strata, rocks, and minerals likewise, in the final analysis, are similarly explained. It seems reasonable, according to Dr. Mendenhall, to expect that further study of the associations and conditions of formation of minerals will yield illuminating correlations with both their chemical composition and physical structure.

Unusual features of the Survey's geologic activities during the year were as follows: Study of the base-exchange properties of river clays, expected to afford a correction of the previously calculated age of the ocean. Completion of an eight-year program of research into the geographic and geologic distribution, physical and chemical properties, and processing of bleaching clays, resulting in placing an important key industry on a firm foundation. This work involved study of more than 4,000 samples of clays from the United States and abroad.



STEAM STAMPS, here seen, are well adapted to crushing the native-copper rock

Steam Stamps *hold their ground* at Ahmeek Mill

Calumet & Hecla treats its amygdaloid rock by jigging, tabling, and flotation

C. Harry Benedict
Metallurgist
Calumet & Hecla Consolidated Copper Co., Lake Linden, Mich.

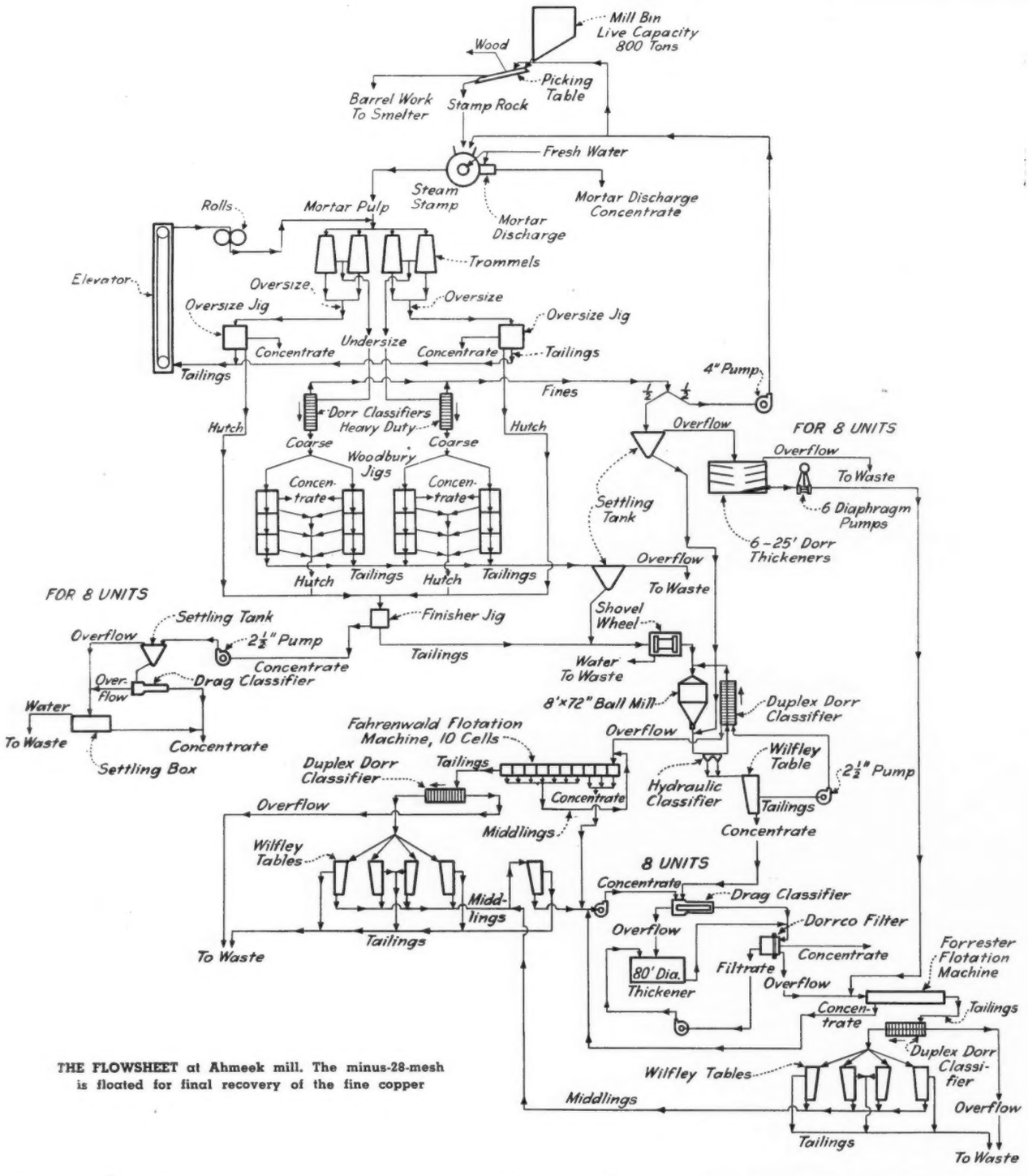
THE AHMEEK MILL of the Calumet & Hecla Consolidated Copper Company is situated along the shores of Torch Lake about a mile from the company's Lake Linden plant, in Houghton County, Mich. The Ahmeek mine itself is about ten miles from the mill. Transportation is by means of a railroad especially built for that purpose on a down grade from mine to mill. Torch Lake is quite deep for an inland body of water, reaching depths as great as 130 ft. fairly close to the shore, and is surrounded by gently sloping hills, so that the site makes an ideal location for access of ore to the mill and also for the deposit of tailings.

The mill was built primarily for the treatment of rock (ore) from the Kearsarge lode, but it is adapted with very slight modifications to the treatment of any amygdaloid so far opened up in the district. The ore treated has native copper as its only economic mineral, as is true of all the ores of the Lake Superior district, but the lodes differ considerably in the size and distribution of the copper particles. It is this factor of the ore, related of course to the total copper contents, that determines such variations as there may be between treatment of the rock from the different lodes.

Lake Superior metallurgical practice differs from that of any other copper-producing district owing to at least two unique characteristics of the ore: one, native copper is present in all sizes from masses weighing many tons down to the microscopic particles, and these particles resist reduction in size; two, the particles of native copper are tougher than the ore and hence more resistant to abrasion and absolutely unfriable.

Careful analysis of the results of these properties of the ore accounts for most of the variation of Lake Superior practice from that of Western districts. Except for the Champion mill of the Copper Range Company, which has developed a hammer type of crusher, the steam stamp has reigned supreme as a preliminary crushing unit in the Lake Superior district for over 60 years, and yet the steam stamp has made no headway in other camps. This superiority over rolls or even gyratory crushers is due to the fact that there is a large clearance between shoe and die in the mortar of the steam stamp, so that the presence of a large nugget of copper causes only slight inconvenience and no breakage, whereas in a crusher with restricted opening such a nugget might prove a very unwelcome visitor. The presence of grains of copper of moderate size ($\frac{1}{8}$ to $\frac{5}{8}$ in.) explains the necessity for jigs or roughing tables preliminary to flotation. If it were possible to crush or grind the ore in one operation to the proper size for flotation, the flowsheet could be simplified.

The mill is a steel and concrete structure, erection of which was begun in 1909 and which originally contained four stamp units. In 1914 four more units were installed, so the present structure houses eight stamps of an approximate capacity of 900 tons each per day, or 7,200 tons nominal daily capacity.



THE FLOWSHEET at Ahmeek mill. The minus-28-mesh is floated for final recovery of the fine copper

In this installation the stamps are compound-cylinder units of Nordberg design. The high-pressure cylinder is 16½ in. in diameter and steam enters it at an initial pressure of 160 lb. Exhaust from this cylinder goes by means of a receiver to the low-pressure cylinder, which is 32 in. in diameter and operates at a pressure of 38 lb. The stamps themselves are non-condensing and the exhaust steam goes at a pressure of 16 lb. absolute to a low-pressure turbine, thus giving a final mechanical economy that makes the efficiency of the combined unit as great as that of an electrically operated crushing device. Boiler pressure is maintained at 420 lb. for initial pressure to the main turbine and steam for the stamp is reduced to 160-lb. pressure by means of a 1,000-hp. reducing turbine.

Rock or ore is fed into the stamp by gravity from the bin, but its flow is controlled by the attendant. The purpose of feeding by hand rather than mechanically is to sort out from the rock the large masses of copper, which are sent to the smelter as a separate grade. However, if a large piece of copper escapes the vigilance of the attendant and gets into the stamp it does no mechanical harm, for there is a clearance of 8 in. between shoe and die at the end of the stroke. The presence of these nuggets of copper within the stamp made a problem for many years in the Lake Superior district, as it is evident that their accumulation would cause difficulties. This situation was met some 40 years ago by introducing an hydraulic discharge within the mortar itself. This discharge is a simple device consisting of an orifice approximately 4 in. in diameter in one of the stave liners of the mortar, the connecting pipe being inclined at an angle of approximately 45 deg. leading to a trap controlled by two valves. Water is forced up through this column at such a pressure that only the

native copper is heavy enough to descend against it, and at appropriate times this copper is discharged by means of the trap. This device makes it unnecessary to remove the screens from the mortar except when the stamp shoe is changed, at which times any large pieces of copper remaining in the mortar are removed by hand.

The stamp operates at a speed of 102 r.p.m., has a stroke of 24 in. and requires an indicated horsepower of 300. Moving parts, without the stamp shoe, weigh 7,000 lb. When new, the shoe weighs 835 lb. and, upon replacement, after the average life of 96 hours, the old shoe weighs 550 lb. These shoes are made in the local foundry, and are of chilled cast iron with a small amount of ferromanganese in the mixture. They have been found more satisfactory than any other iron or steel product, outwearing other materials tried for the purpose except nickel steel, and also are much cheaper per pound weight and per ton crushed than the various high-class substitutes tried. The mortar is lined with the same kind of material. The blow is received on a circular die 24 in. in diameter and 6 in. high. This die is held in place by a circular horizontal ring, and the vertical stave liners lining the mortar are in turn held in place by one king stave, which is bolted through the mortar casing. The shoe can be changed in less than half an hour. With the mortar lined throughout, there are few interruptions in operating the stamp. The accompanying photograph shows a view of the main stamp floor.

The stamp mortar has a two-way discharge, giving ample screening capacity for the stamp product. Each mortar has eight screens 9¼x48 in. in size, with ⅝-in. round openings. Material discharged from the stamp goes to four trommels with 3/16-in. round openings. Trommel oversize goes to a bull jig which makes a concentrate assaying over 90 per cent copper, the tailings going to a 36x16-in. high-speed Nordberg roll. Discharge of this roll joins the stamp product to go to the original four trommels, so that the bull jigs and rolls are in closed circuit with the stamp, and material cannot leave this circuit until crushed to 3/16 in. and naturally free of all copper above this size.

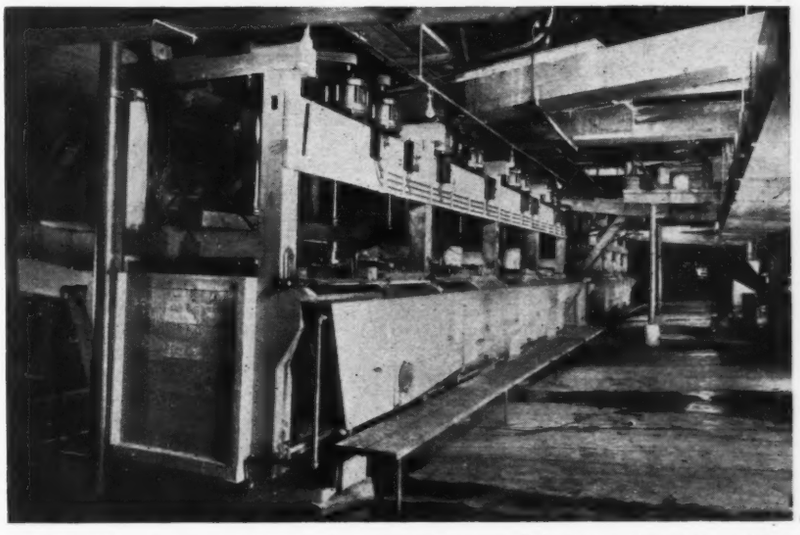
Material passed through the trommel screens, now finer than 3/16 in. in size, is classified into slimes and sand by means of two Dorr classifiers 3 ft. wide and 18 ft. 4 in. in length. Half of the slimes from these classifiers are returned to the stamp to save a corresponding volume of fresh water and thereby decreasing the dilution, and the other half by volume goes to a small settling tank, the plug product of which serves as dilution water in the grinding circuit and the overflow of which goes to flotation after being settled and thickened in a series of Dorr thickeners.

The rake product from each Dorr classifier is treated on two Woodbury jigs to remove the free copper, and the jig tailings are ground in an 8 ft. by 72 in. Hardinge ball mill. The ball mill has a capacity of approximately 550 tons per 24 hours and is in closed circuit with a heavy-duty duplex Dorr FX classifier 8x25 ft. in size. The circulating load is about 300 per cent, and crushing is held as nearly as possible to —28 mesh.

In connection with the closed-circuit system described in the foregoing, it becomes necessary to free the circuit of the coarser copper liberated in grinding. This is done by introducing into the circuit between the discharge of the ball mill and the Dorr classifier an hydraulic classifier, the plug product from which is treated on a Wilfley table, the tailings of which are returned to the ball mill. This has been found efficient in removing the coarser liberated values from the circuit. The same effect could be obtained by the use of a mineral jig such as the Denver mineral jig.

Grinding is done at 75 per cent solids. After grinding the plug product from the slime settling tank previously mentioned, water is added, which gives a dilution preliminary to classifying of about 60 per cent solids and a feed to the flotation machines of about one part sand to two parts water.

AHMEEK MILL (left) and the adjacent power plant. Steel ore bins top the concrete structure into which have been built the coal bins, supplied by chutes from the railroad track overhead



FLOTATION of the finer sizes of native copper is accomplished in a Forrester machine, handling the original slimes, and in Fahrenwald machines (here seen) that take the ball-mill product

The flowsheet is shown. It will be noted that, as already outlined, it embraces four principal operations: (1) Preliminary crushing of the ore to ⅝ in. in the stamp with closed-circuit grinding to —3/16 in., by means of rolls and trommels, and a bull jig for removing liberated copper. (2) Classification of the 3/16-in. material into slime and sand and jigging of the sand to concentrate out the coarser liberated copper. (3) Closed-circuit grinding by means of a ball mill and classifier to —28 mesh with recovery of the coarser liberated copper on a Wilfley table within the closed circuit. (4) Flotation of the —28 mesh material to make a final recovery of the

fine copper. For flotation there is in use both a Forrester machine, which takes the original slime from the stamp and roll crushing from all stamp units, and a Denver flotation unit for the ball-mill product from each stamp unit. The Forrester machine treats approximately 1,100 tons per 24 hours at full capacity. It is 40 ft. in length. Of the 900 tons of rock stamped per stamp unit, about 180 tons is primary slime, which, after being settled in 25-ft., three-tray thickeners, goes to the Forrester machine. This machine does excellent work on this fine material and the tailings rarely run over 0.05 per cent.

Treatment of the slimes that go to the Denver flotation machines shown in the flowsheet is summed up briefly. The density of the pulp as it enters the first cell is 33⅓ per cent solids, and the final concentrate is taken from the first two cells. From the remaining cells a rougher concentrate or middling is re-treated by being returned to the first cell. Concentrates from the first two cells average about 60 per cent copper and do not require recleaning of any description.

Flotation tailing flows to a 4 ft. 6 in. duplex classifier, which makes an overflow averaging 0.04 per cent copper and amounting to 80 per cent of the tailing by weight. This is discarded. The sand product, amounting to 20 per cent, is treated on four Wilfley tables, from which a small amount of copper is recovered that has proved to be too heavy to float. These table tailings are combined with the classifier overflow and the tailings of the Forrester machine to make a final tailing of about 0.075 per cent on an original feed to the stamps of from 26 to 32 lb. per ton. This gives a recovery of approximately 95 per cent.

Flotation concentrate is pumped to a drag classifier, where the easily settling portion is dragged directly to a Dorreo filter. The overflow of this drag flows to a 30-ft. traction thickener, and the thickened product is elevated by means of a diaphragm pump to the classifier discharge, where it helps to wash the heavier copper into the filter. This filter discharges its cake into a concentrate bin emptying directly into 50-ton hopper-bottom cars. The filter cake carries about 11 per cent moisture, and, as stated before, the dry assay is approximately 60 per cent copper.

Typical screen analyses of flotation feed and final tailings after tabling are given in Table I. These tailings, except for the portion of the original slimes which go to the Forrester machine and some unimportant overflows, represent the final tailings from the ore.

Flotation reagents used are sodium ethyl xanthate and pine oil. It has not been found commercial to use any of the higher xanthates nor is it necessary to use any lime in the circuit. The xanthate consumption is about 1/20 of a pound per ton of ore and the pine oil 1/10 of a pound.

Concentrates as shipped to the smelter are divided into four grades. The copper that is picked out at the steam stamp is in such masses that it is impossible to sample them, and it is shipped under the designation of "mill mass" with an assay that is estimated from an occasional specific gravity test. The copper from the mortar discharge, from the ⅝-in. bull jigs, and from the 3/16-in. Woodbury jig, is shipped as one grade and can be sampled with a moderate amount of accuracy by means of a slotted bar. This material assays well over 90 per cent copper at all times. The concentrates obtained from the Wilfley table in closed circuit with the ball mill and those from the jigging of the hutch product of the Woodbury jigs go to the smelter as a separate grade and assay 80 per cent copper on the average. The fourth product consists of the Forrester and Fahrenwald flotation concentrates assaying 60 per cent copper. Average of all concentrates will assay about 78 per cent copper.

Tailings are pumped by a 16-in. centrifugal pump to the launder, which carries them out to Torch Lake. Within the mill some of the overflows containing moderate amounts of slime are re-used to conserve water and prevent dilution of the slime products. In general, because of the large amount of water available and the low cost of pumping, there is a tendency to use an excess of it in all operations. This results in excessive dilution and necessitates large settling areas for all fine products.

With the mill running at capacity the costs are approximately 30c. per ton milled. Of this one-half is for stamping, one-sixth for regrinding, one-sixth for flotation, and one-sixth for concentrating and miscellaneous costs other than flotation. Electricity costs on the average 0.35c. per kilowatt-hour and total power requirements amount to 14 kilowatt-hours per ton. This is in addition to steam used for stamping. Summarized figures for the year 1937 are given in Table II.

Table I—Typical Analyses of Flotation Feed and Final Tailings

	Flotation Feed		Flotation Tailing		Final Tailing	
Mesh	% Wt.	Assay	% Wt.	Assay	% Wt.	Assay
−35...	7.9	0.50	8.4	0.45	7.7	0.23
−48...	9.0	0.50	10.0	0.20	9.0	0.12
−65...	14.0	0.52	14.7	0.08	15.1	0.06
−100...	17.1	0.46	17.1	0.05	17.3	0.06
−150...	6.9	0.42	5.6	0.05	5.7	0.05
−200...	4.6	0.44	3.1	0.05	6.6	0.04
−200...	40.5	0.19	41.1	0.03	38.6	0.03
Total....	100.0	0.37	100.0	0.09	100.0	0.07

Table II—Data, Ahmeek Mill, 1937

Tons ore treated, tons	945,403
Stamping rate per 24 hours, tons	881
Rock treated per pound stamp shoe worn, tons	15.56
Rock treated per ton coal consumed, tons	65.32
Rock treated per employee per day, tons	25.30
Ratio concentration	60:1
Recovery — Mill mass, %	5.0
High-grade concentrate, %	53.0
Low-grade concentrate, %	27.7
Flotation, %	14.3

Mechanical Loading in the Butte Mines

(*Continued from page* 37)

built to their original size and the same interchangeability as new parts is maintained.

A minimum of delays due to breakdowns requires the loader to be designed and built to withstand rough handling and abuse. All parts requiring replacement should be readily accessible, making for quick removal and assembly. Major breakdowns should be infrequent and the dirt loaded between periods of overhauling should be at least 75,000 cu.ft. It takes three or more overhaulings to determine all wear points and other weakness in design and construction. Maintenance cost is highly important, and it is dependent on the care taken of machines.

The ultimate life of a mechanical loader is difficult to determine, although for depreciation purposes it may be estimated to be between five and seven years. In the early development of equipment the life is generally governed by improvements in design, making the older models obsolete.

Mechanical loading has become so effective in reducing costs and speeding up work that it can replace hand loading and effect a saving in any drift 7 x 5 ft. or larger in cross-section. The greatest direct saving can be obtained in those working places where heat and humidity make hand loading extremely fatiguing. The amount of direct savings effected depend largely on the planning of the work and the car service, and the maintenance of equipment in good operating condition. In certain conditions where the bulk of overhead is carried by drifting operations, increasing the rate of advance of headings by the introduction of these loaders reduces the overhead charge directly.

The development of mechanical loaders during the past few years forecasts some revolutionary changes in drifting operations. The loaders are fast and efficient in operation, and are being improved rapidly to eliminate minor breakdowns, and maintenance costs are being reduced to a satisfactory point.

PERSONAL ITEMS

Herbert G. Rydell has returned from the Philippines and is at Willamina, Oregon.

Frank Cameron has gone to the property of La Luz Mines, Ltd., Siuna, Nicaragua.

G. Finlayson, of Glasgow, Scotland, has gone to Dunkwa, Gold Coast Colony, West Africa.

Harold J. McClelland is now with the American Zinc-Lead Company at Metaline, Wash.

Samuel H. Dolbear lately inspected properties of the Austin Silver Mining Company at Austin, Nev.

E. C. Howe has left Arequipa, Peru, and is now at Puno, Peru, care of Minas de San Antonio de Esquilache.

G. N. Helling, formerly at Tegucigalpa, Honduras, is manager of Mina San Gerardo, Sam Ramon, Costa Rica.

George W. Harris has left the San Francisco Mines, San Francisco del Oro, Chihuahua, Mexico, and is at 424 North 9th St., Santa Paula, Calif.

J. L. Bruce, resident director of the Cyprus Mines Corporation, has returned to the United States and is at 3244 Lowry Road, Los Angeles, Calif.

Ernest Klepetko, Pacific Palisades, Calif., consultant for Combined Metals Reduction Company, has gone to the company's property at Stockton, Utah.

W. E. Crawford, formerly mill superintendent for the Fresnillo Company, Zacatecas, Mexico, is temporarily located at 115 Champion Place, Alhambra, Calif.

Edwin Sweetman, mining engineer of Virginia, Minn., was a November visitor to New York, where he attended a meeting of the Consolidated Coppermines Corporation.

Donald B. Gillies, vice-president of Republic Steel Corporation, has been elected president of the American Institute of Mining and Metallurgical Engineers for 1939.

A. G. Robertson, mining engineer for Consolidated Mining & Smelting Company of Canada, has removed from Chapman Camp, B. C., to Big Missouri Mine, Stewart, B. C.

Fred E. Browne, mining engineer with present headquarters at Auburn, Calif., lately directed the sampling of gold properties in the Douglas district in Mineral County, Nev.

Andres Soriano, head of the Soriano mining interests, who has spent about six months abroad in Europe and the United States, is expected back in Manila in December.

Gailen T. Vandel has returned to the United States from Bolivia, where he was with Bolivian International Mining Corporation, and can be reached at Box 38, Route 1, Grants Pass, Oregon.

J. V. N. Dorr was the recipient on Nov. 4 of the Chemical Industry Medal which is awarded annually by the Amer-

J. V. N. DORR

ican Section of the Society of Chemical Industry. The presentation was made by Victor G. Bartram, of Montreal, Canada, president of the Society, following a review of the life and accomplishments of the medallist by H. C. Parmelee. In Mr. Dorr's speech of acceptance he discussed the merits and demerits of patent systems, drawing on his own experience for 30 years in the field of sedimentation.

Harmon G. Lichtenstein, of 52 Broadway, New York City, has taken over the business of L. Hirshler and the New York office of S. A. de la Vieille Montagne, Chenee, Belgium.

A. D. Falck, Jr., formerly engineer on the staff of the Basin Montana Tunnel Company, is now in the geological department of the Anaconda Copper Mining Company at Butte, Mont.

Albert H. Hahn, consulting metallurgist and president of Metalead Products Corporation, recently returned to his San Francisco office following a trip to New York City.

Angus D. Campbell, of McIntyre Porcupine Mines, Ltd., Schumacher, Ont., Canada, has been designated a member of the mining section of the executive committee of the National Safety Council, 20 North Wacker Drive, Chicago.

R. E. Himebaugh, mill superintendent at the Teziutlan unit of Cia. Minera Asarco, Puebla, Mexico, has been transferred to the Angangueo unit in Michoacan, due to the closing of the former unit.

Frank Cooper has resigned his position as general manager of Minas del Tajo S. A., at Rosario, Sinaloa, Mexico, and for the present may be addressed care of R. A. Orrett, 442 Sansome St., San Francisco, Calif.

Reed E. Roberts, superintendent of the Zacatecas unit of the Fresnillo Company, Fresnillo, Zac., Mexico, has gone to Estacion Lodomena as general superintendent of Cia. Candelaria Conoas. **Ira A. Herbert,** of the latter company, has gone to Fresnillo.

Frank C. Brown, well-known mill operator and metallurgist of Los Angeles, has been appointed as assistant to **A. E. Place,** manager, and mill superintendent at the Wall Street mine, Nelson, Nev. His address is care of Wall Street mine, Nelson, Nev.

E. C. Peterson has resigned his position as metallurgist in the Mexican Mining Department of the American Smelting & Refining Company and will soon return to the United States to accept a position as metallurgist for the International Smelting & Refining Company at Ophir, Utah.

John F. Emerson is now engaged in Arizona as a surveyor and geologist for **S. J. Clausen** and **Arthur Letts, Jr.,** who are opening up some gold properties in the southern part of the State. His address is general delivery, Hillside, Ariz.

R. Murray-Hughes left England on Nov. 23 for a visit to South America, traveling via Trinidad. His address while he is abroad will be care of the Curacao Trading Company, Paramaribo, Dutch Guiana.

Carlos W. Van Law will return to South America on Dec. 16, taking direct plane from New York to La Paz, Bolivia, where he will assume management of the Corocoro operations of the American Smelting & Refining Company, 65 miles from La Paz. His address is care of the company named, Corocoro, Bolivia.

Dr. Andrew Cowper Lawson, 77 year old professor emeritus of geology and mineralogy at the University of California, has been awarded the Penrose Medal, the highest honor of the Geological Society of America, for "eminent research in pure geology and outstanding original contributions and achievements which mark a decided advance in the science of geology."

Dr. H. Foster Bain, adviser on mining to the Philippine Government, and **Quirico Abadilla,** director of the Bureau of Mines, went to Japan in late September to confer with Japanese officials on the sale of iron ore from the vast deposit being opened by the National Development Company in Surigao. They planned to return to Manila in December.

James H. McGraw, Jr., chairman of the board and president of the McGraw-Hill Publishing Company, Inc., has been elected to the board of directors of the American Arbitration Association. As a director of the Association, Mr. McGraw will participate in the development of its Voluntary Industrial Arbitration Tribunal, which has just completed its first year of operation with a record of more than 100 arbitrations of labor disputes which have been settled under its rules.

OBITUARY

John L. Mullen, formerly auditor of the Oliver Iron Mining Company, died in Los Angeles on Oct. 28. He retired in March, 1936.

Hartwell J. Elmendorf, mining engineer associated with the Columbia Steel Company, died recently in Los Angeles, Calif., at the age of 45.

William Henry Merrett, instructor in the British Royal School of Mines from 1901 to his retirement in 1937, died on Oct. 29 at the age of 66.

H. F. Donaldson, who was connected with San Francisco del Oro Mining Company, in Chihuahua, Mexico, died on Oct. 21 last after an illness of four months.

A. D. Spiers, chairman of directors of Aberfoyle Tin, N.L., and Mount Rex Tin, N.L., and a director of several other mining companies, died in Melbourne on Oct. 2.

Hurlbut S. Jacoby, director of industrial research and field director of the Engineering Experiment Station at Ohio State University since 1934, died on Nov. 16 at the age of 62.

Sir Robert Mond, who, with his father, Dr. Ludwig Mond, discovered the gaseous metallic compound nickel carbonyl, died in Paris on Oct. 22 last. As chairman of the Mond Nickel Company, in 1919, Sir Robert was primarily responsible for initiating the enterprise of separating and refining the platinum metals from the end products of the Mond carbonyl process.

Arnold W. Harris, consulting engineer, died recently in Perth, W.A., from the effects of injuries received in an automobile accident. He was 48 years old. Mr. Harris went to Australia about nine years ago as construction engineer for Wiluna Gold Mines Ltd., and later became mill superintendent. He went to Kalgoorlie about three years ago, and had built up an extensive consulting practice.

Joseph Clendenin, affectionately known as "Uncle Joe" by his associates, who for nearly 60 years had been prominently identified with the copper industry, died at his home at Kirk Hills, Ardsley-on-Hudson, N. Y., on Dec. 1, at the age of 83. He was born in Baltimore, and when twenty joined the Baltimore Copper Smelting & Rolling Company, the first producer of electrolytic copper on a commercial basis. In 1917 the Baltimore company was taken over by the American Smelting & Refining Company and Mr. Clendenin became a vice-president of that corporation. In 1921 he became copper sales manager for Guggenheim Brothers. He retired in 1934. He was chairman of the Copper Producers Committee of the War Industries Board during the World War. His services brought him the commendation of the Belgian Government, the decoration of Chevalier of the Legion of Honor from France, and the official recognition of his services by the chairman of the board, Bernard M. Baruch.

Max A. Koeckert

An Appreciation by Heath Steele

The successful career of Max A. Koeckert, manager of the United States Metals Refining Company at Carteret, N. J., came to a tragic end on Oct. 23, 1938, when he and his wife met instantaneous death in an automobile accident. Mr. Koeckert was born on Nov. 16, 1884, in Cleveland, Ohio. His work in the metallurgical industry started on one of the lowest rungs of the ladder, when in 1904 he found employment as a checkweigher with the United States Metals Refining Company at Carteret. From this position he climbed successively to that of assistant foreman in the tank house, chief weigher, weighmaster, production superintendent, assistant manager, and finally general manager. During his 34 years of service he contributed much to the growth, development, and progress of the plant. Especially marked was his successful handling of management problems in the past ten difficult years. Mr. Koeckert knew personally the majority of his men and he was highly respected and sincerely liked by all. His untimely passing has deeply affected his fellow workers.

The officers and directors of American Metal and United States Metals Refining have passed resolutions expressing their deep sorrow and appreciation of him as a good friend as well as a valued operator. He is survived by his son, Fred. A. Koeckert, who is married and lives in Metuchen, N. J.

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A LETTER

Mining in the Philippines

The Editor:

MY ATTENTION has been called to the letter from Mr. Ralph Keeler published in your issue for August last, and the preceding correspondence.[1] Perhaps I may be able to clarify the situation a little.

Mr. Keeler cites as one reason for the fear which he says is felt by the mining industry of undue interference by the Philippine Government, the provisions of Commonwealth 136 and 137 giving the Department of Agriculture and Commerce authority to issue regulations (Sec. 77) and the Bureau of Mines police power over the mines. It is quite true that Section 77 of Act 137 is more specific than the corresponding sections in the law (Pub. 146, 66th Cong.) giving the Secretary of Interior similar authority over the leased lands of the United States; but the authority is not broader, and, as a matter of fact, the regulations issued at Washington are much more detailed than any put out at Manila. There are certain American petroleum and mining companies which "fear" to work on the public lands or at least prefer not to do so, but many others equally big and equally experienced take leases. Literally millions of tons of coal and barrels of oil are produced under regulations much more detailed than any suggested here. In fact American companies often bid large premiums for the privilege of producing under the United States leasing law. It would hardly seem, therefore, that either the leasing system itself or the reserved power to regulate is warrant for or actually generates any such widespread "fear" as Mr. Keeler's first letter implied.

It is quite true also that the law and the regulations might be unexceptional; but if the administration was bad, and especially if it were unfair or vindictive as is at least suggested, operations would be made difficult or impossible. Is there any real evidence that this condition obtains in the Islands? In the matter of right of cancellation of leases, it is true that the Secretary has the right of action without prior reference to the Courts and that the Bureau of Mines opposed setting up the latter requirement; but the action of the Secretary is subject to review by the Courts and the latter are freely open to any one feeling himself aggrieved. The insertion of the proposed word "or," (not "of" as printed) would have required reference of all cases to the Courts, even where the lessee was prepared to admit the justice of the cancellation. The Courts have their own functions to perform. They should not be needlessly loaded. It is also to be noted that the wording of the law is that "the lease *may* be forfeited and cancelled" not that it *shall.* The Secretary is given discretion and anyone with any experience whatever in public administration and the power of a pressure group will recognize that no Secretary will in fact cancel a lease unless he has sufficient grounds to permit him to expect his action to be sustained in case of contest in the Courts.

It comes down therefore to, first, the capacity of the administrative officers; and second, the spirit in which they perform their duties. It is sadly true that in Manila, as at Washington, and in every capital in which I have had experience, instances may be cited of wooden headed administration. A bout with our own income tax officials, Federal or State, will usually convince one of the truth of this. In the Philippines there is a special reason for it which it is but fair to remember. There are not, as yet, an adequate number of experienced administrators. This is not

surprising when it is remembered that for three centuries, the Spaniards in only the rarest instances ever permitted the Filipinos to exercise administrative authority, and that through forty years thereafter, the impatient Americans stepped in and made the decisions whenever a Filipino official seemed timid or confused. In the Orient, where family ties are strong, it is not usual for an individual to take responsibility and make clear cut prompt decisions. It will take time to accustom enough men to do this, to man the public service adequately. Meanwhile there will be here, as is true to much too great an extent elsewhere, a tendency to pass the buck or slavishly to follow the words of a text whatever this may do to the spirit.

In my judgment, it is this rather than any vindictive attitude toward mining or in industry which leads to such matters as the argument with the Collector of Internal Revenue over his right to review the computation of output tax in recent years. Tax collectors are apt to be overcareful from the tax payers' point of view, but if they fail to maintain any possible claim of the Government, they are subject to condemnation by any politician who sees political capital in criticising them. This is true everywhere. By way of comparison, consider Section 820 of the regulations issued at Washington for operation under the Revenue Act of 1938. This reopens certain classes of income taxes clear back to 1932 even when closed by the statute of limitations.

Personally, I have found the present Collector of Internal Revenue at Manila eminently fair minded and willing on cause to reverse his subordinates in such matters. He has cooperated heartily in preparing amendments to the Mining Law to remove certain difficulties met in practice. That these were only in part passed by the late National Assembly is but common experience in such matters and merely throws on mining men both in and out of the Government the burden of another trial.

As to the attitude of the Bureau of Mines in the matter of patents and leases, Mr. Keeler has been misinformed. There are not now and never have been 100 applications for leases pending before the Bureau. The total number filed to date is 37 and the number granted 6. As for patents, in August, 1930, the Bureau of Lands, which was then in charge of such matters, sent out a circular letter to mining locators of record, enclosing an application and calling their attention to the conditions under which they could secure patent. Nobody has been more anxious than the Government to clear the records and determine what is public domain and what is private land; but miners are notoriously lax about going to patent on claims. In all, 186 lode and 21 placer patents were approved, and only 37 lode applications with none for placer are now pending.

It was only after the establishment of the Commonwealth when, legal doubts having arisen as to whether or not land could any longer be alienated by patent, action on further applications was suspended. Even so, those which had reached a certain advanced stage went ahead and Patent 149 was issued as late as January 22, 1937.

The Constitution of the Commonwealth forbids alienation of any but agricultural land and there was legal doubt as to the status of mining claims staked prior to the establishment of the new law, and of the right of claimants under the old law to proceed to patent. The Administration took the view that such a matter should be determined by the Courts, and administrative action on pending claims, except as above, was suspended until this could be done. This was clearly wise, since no mere opinion of a Secretary or an Attorney General would have been binding, and a dangerous flaw might have crept into any titles granted. In consultation with representatives of the mining industry a test case was selected and was prosecuted by the Balatoc Mining Company. It was contested by the Solicitor of the Department of Justice, as was his duty. When in the course of the trial it appeared that the particular case involved collateral issues which might defeat the patent aside from the constitutional issue involved, the Administration promptly took the lead in selecting other cases which would test the constitutional question without such complication. In discussing the NOB Fraction case the Solicitor General said that while he must deny certain of the allegations made, he was agreeable that it be "submitted on the facts averred by the complainants," which was certainly as fair as could be asked. This case has just been decided by a nearly unanimous holding of the Supreme Court in favor of the mining claimants, and directs the Secretary and the Director to consider the application for patent on its merits under the old law, which will be done.

As illustrating the attitude of the Administration I may point out that at the instance of the latter, the National Assembly last spring amended Act 137 so as to extend for two years the time within which claimants under the old law might apply for lease or lose their claims in case the Court decided against them. This was to prevent any injustice or undue pressure on the claim holders, and that it represents the sincere attitude of the Administration, comes within my personal knowledge. It is proposed that full justice be given the mining claimants; and work had in fact been done on remedial legislation to be proposed to the Assembly in case the decision had gone the other way. On the other hand the Government is determined, and I believe rightly so, to exercise its full powers to clear up the records and prevent the mining law being made a farce as it is now in the United States, where claim stakers rather than miners have come into control and assessment work has long been a joke. Incidentally there is full authority there for doing this in the old law to which the mining companies appealed and which has just been sustained by the Court.

Mr. Keeler mentions two other matters which, while minor, warrant each a word. The first was the attitude of the Securities and Exchange Commission ". . . in imposing all sorts of restrictions in connection with the issuance of stock for the purpose of organizing mining companies." It is hard to believe he is serious in this, in view of the flood of worthless wild cats which managed to get loose and bite the public, despite the "restrictions." It is too much to expect that a small Commission, however honest and able, should not make some mistakes; but it would, I think, now be the general opinion that such mistakes as were made were rather as to those the Commission let through than those it stopped.

The other matter is with regard to the attitude of the Bureau of Mines in connection with the valuation of mining properties, and he cites the Mindanao Mother Lode in reprobation. In June 30, 1937, the Bureau of Mines, on the basis of a report by the consulting engineer of that company, placed a valuation of 115,000 pesos on the property as of that date. It is also true that within a few succeeding months the company shipped a gross amount much larger than this valuation. What of it? Since when has gross production been equivalent to present net value? As a matter of fact much of the ore shipped and entering into the total Mr. Keeler cites, was taken from ground opened after the valuation was made by the Bureau. It is also a fact of record that the company has not even yet been able to pay any dividends and has been in various difficulties. It may ultimately produce much more than the gross Mr. Keeler cites and yet never make good even on the valuation given it by the Bureau. We hope this will not prove true, for the vein is a very interesting one containing rich ore, though as yet unfortunately found only in spots and short shoots. It may at some subsequent time be worth much more than it was when the Bureau valued the mine, but the difference between present net value and gross production is something which ought not be confused by any mining man.

A good many years ago the rule was laid down in the United States that the power to tax is the power to destroy, but it has seldom been so used, and in the Philippines as well as the United States there is a flourishing and growing mining industry despite this inherent power in the Government. Whatever may come to be true in the future, mines are now taxed here much more lightly than in many other countries, which is correct and proper since this is a pioneer country where mining is still an infant industry. This tendency to dwell on the terrible things which may happen hardly appeals to me as wise, though it may be that actual shudders have been induced by such contemplation. It was Eugene Field I believe who said:

> "It don't made no difference
> Whether things is black, or white.
> When you get to seeing things
> At night."

That though should be the occupation of small boys—not hard boiled mining men.

H. Foster Bain,
Mining Adviser
Bureau of Mines, Manila, P. I.

[1] Editor's Note. The controversy between Mr. Keeler, *E. & M. J.* correspondent in Manila, and Quirico Abadilla, director of the Bureau of Mines, grew out of statements made by the former in a review of Philippine mining published in our issue for February, 1938. Mr. Abadilla's exceptions were published in June, and a reply by Mr. Keeler in August. Without prejudice to either of the principals, the discussion will be closed with publication of Mr. Bain's review of the matter.

Summary of the

MARKETS

CONSUMPTION of non-ferrous metals in this country during November continued at about the same rate as in the preceding month, but buying slackened appreciably as the price situation became unsettled, reflecting weakness abroad. The nearness of the inventory period also made buyers act with reserve. Copper prices in the domestic market remained unchanged, but lead and zinc were lowered. The *E.&M.J.* index of prices for November was 78.36, against 77.61 in the preceding month, the slight rise resulting from higher monthly averages for both copper and tin.

The domestic copper industry sold only 12,524 tons of copper during November, which contrasts with 78,288 tons in October. Though the established quotation held at 11¼c., Valley, throughout the month, the industry was disturbed over transactions at concessions that were made in some directions through the use of Commodity Exchange warrants. Not only did the London market move downward, but the break in sterling exchange added to the general unsettlement in the foreign situation. The foreign group reinstated production control, announcing that output at the rate of 110 per cent of the basic tonnages would become fully effective by Jan. 1, 1939.

In spite of favorable statistics, lead became depressed. Buyers centered their attention on the decline in the London equivalent, due to sterling, and bought sparingly as the month ended. The price was lowered 10 points to 5c., New York.

The unexpected reduction in the duty on zinc, established under the revised Canadian trade agreement, disrupted business and the price broke sharply to ward off foreign competition. Prime Western zinc was reduced to 4.50c. per pound, St. Louis, a net loss of 55 points.

Production of tin will continue at 45 per cent of standard tonnages in the first quarter of 1939, with 35 per cent allocated for consumption and 10 per cent for the Buffer Pool.

UNITED STATES MARKET

	Electrolytic Copper		Straits, Tin	Lead		Zinc
1938 Nov.	Domestic (a)	Export (b)	New York	New York	St. Louis	St. Louis
1	11.025	10.800	46.350	5.10	4.95	5.05
2	11.025	10.800	46.100	5.10	4.95	5.05
3	11.025	10.775	46.375	5.10	4.95	5.05
4	11.025	10.800	46.350	5.10	4.95	5.05
5	11.025	10.800	46.275	5.10	4.95	5.05
7	11.025	10.800	46.250	5.10	4.95	5.05
8	Holiday	10.850	Holiday	Holiday	Holiday	Holiday
9	11.025	10.900	46.500	5.10	4.95	5.05
10	11.025	10.975	46.700	5.10	4.95	5.05
11	Holiday	10.925	Holiday	Holiday	Holiday	Holiday
12	11.025	10.925	46.850	5.10	4.95	5.05
14	11.025	10.850	46.750	5.10	4.95	5.05
15	11.025	10.675	46.450	5.10	4.95	5.05
16	11.025	10.675	46.550	5.10	4.95	5.05
17	11.025	10.425	46.300	5.10	4.95	5.05
18	11.025	10.425	46.250	5.10	4.95	5.05
19	11.025	10.425	46.250	5.10	4.95	5.05
21	11.025	10.300	46.100	5.10	4.95	4.75
22	11.025	10.250	45.925	5.10	4.95	4.75
23	11.025	10.325	46.100	5.10	4.95	4.75
24	Holiday	10.350	Holiday	Holiday	Holiday	Holiday
25	11.025	10.400	46.000	5.10	4.95	4.75
26	11.025	10.350	45.800	5.10	4.95	4.75
28	11.025	10.025	45.700	5.10	4.95	4.75
29	11.025	9.975	45.850	5.00	4.85	4.50
30	11.025	10.000	46.250	5.00	4.85	4.50
Average for month	11.025	10.56*9*	46.262	5.091	4.941	4.924
Nov.			**AVERAGES FOR WEEK**			
2	11.025	10.908	46.200	5.10	4.95	5.05
9	11.025	10.821	46.350	5.10	4.95	5.05
16	11.025	10.838	46.660	5.10	4.95	5.05
23	11.025	10.358	46.154	5.10	4.95	4.90
30	11.025	10.183	45.920	5.06	4.91	4.65
Nov.			**CALENDAR WEEK AVERAGES**			
5	11.025	10.796	46.258	5.10	4.95	5.05
12	11.025	10.896	46.575	5.10	4.95	5.05
19	11.025	10.579	46.425	5.10	4.95	5.05
26	11.025	10.329	45.985	5.10	4.95	4.75

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

	Sterling Exchange		Silver		Gold	
1938 Nov.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	4.751250	4.737500	42.750	19.5625	146s 3½d	$35.00
2	4.755000	4.741250	42.750	19.5000	146s 1d	35.00
3	4.756875	4.744375	42.750	19.6250	146s 1½d	35.00
4	4.759375	4.748125	42.750	19.5000	146s 1d	35.00
5	4.760625	4.750625	(e)	19.6250	146s 1d	35.00
7	4.756250	4.745000	42.750	19.5625	146s 1½d	35.00
8	Holiday	Holiday	Holiday	19.5625	145s 11½d	Holiday
9	4.753125	4.741875	42.750	19.6250	146s 3d	35.00
10	4.746250	4.732500	42.750	19.6250	146s 5½d	35.00
11	Holiday	Holiday	Holiday	19.6250	146s 7½d	Holiday
12	4.727500	4.713750	(e)	19.6250	146s 9d	35.00
14	4.710000	4.695000	42.750	19.6875	146s 8d	35.00
15	4.700000	4.683750	42.750	19.9375	148s 3d	35.00
16	4.698750	4.681250	42.750	20.0000	148s 1d	35.00
17	4.705000	4.688750	42.750	19.8750	147s 10½d	35.00
18	4.706250	4.690625	42.750	19.8750	147s 7d	35.00
19	4.697500	4.680625	(e)	19.9375	147s 11d	35.00
21	4.690000	4.673125	42.750	20.0625	147s 11½d	35.00
22	4.662500	4.644375	42.750	20.0625	148s 9d	35.00
23	4.666250	4.648750	42.750	20.1250	149s 2d	35.00
24	Holiday	Holiday	Holiday	20.0625	149s 2d	Holiday
25	4.640000	4.621875	42.750	20.1250	149s 10½d	35.00
26	4.625000	4.608125	(e)	20.1250	150s	35.00
28	4.645000	4.628125	42.750	20.0625	149s 9½d	35.00
29	4.650000	4.632500	42.750	20.2500	149s 3d	35.00
30	4.672500	4.655625	42.750	20.0625	149s 1d	35.00
Average for Mo.	4.70587	.....	42.750	19.834	.....	35.00
Nov.			**AVERAGES FOR WEEK**			
2	4.75938	.....	42.750	.....	.....	.....
9	4.75725	.....	42.750	.....	.....	.....
16	4.71650	.....	42.750	.....	.....	.....
23	4.68792	.....	42.750	.....	.....	.....
30	4.64650	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver, Nov. 5th, 42.750; 12th, 42.750; 19th, 42.750; 26th, 42.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1938, the U. S. Government's price on newly mined domestic silver was established at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛ c. per ounce throughout November.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quotated by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1938 Nov.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	46.0000	46.2500	52.0000	212.5000	213.2500	16.0625	16.1250	16.2500	16.3125	14.8125	14.8750	15.0625	15.1250
2	45.7500	46.0000	51.7500	211.7500	212.7500	16.0000	16.0625	16.1875	16.2500	14.5625	14.6250	14.8125	14.8750
3	45.6250	45.8125	51.5000	212.0000	213.0000	15.7500	15.8125	15.9375	16.0000	14.4375	14.5000	14.6875	14.7500
4	45.5625	45.7500	51.5000	212.0000	212.7500	15.7500	15.8125	15.9375	16.0000	14.4375	14.5625	14.6875	14.7500
7	45.8125	46.0625	51.7500	212.0000	213.0000	15.9375	16.0000	16.1875	16.2500	14.5625	14.6250	14.8125	14.8750
8	46.1250	46.3750	51.7500	212.2500	213.2500	16.1250	16.1875	16.3125	16.3750	14.5625	14.6875	14.8125	14.8750
9	46.6250	46.8750	53.0000	212.5000	213.5000	16.4375	16.5000	16.6250	16.6875	14.6875	14.7500	14.9375	15.0000
10	46.6875	46.9375	52.5000	214.2500	214.7500	16.2500	16.3125	16.4375	16.5000	14.7500	14.8125	14.9735	15.0000
11	46.7500	46.9375	52.2500	214.2500	215.1250	16.1250	16.2500	16.3125	16.3750	14.6875	14.7500	14.8750	15.0000
14	46.3125	46.5000	52.0000	216.2500	216.7500	16.2500	16.3125	16.5000	16.5625	14.6250	14.7500	14.8125	14.8750
15	45.3125	45.5625	51.5000	215.2500	215.7500	16.0000	16.0625	16.1875	16.2500	14.3750	14.4375	14.6250	14.6875
16	45.8125	46.0000	51.5000	215.2500	216.0000	15.9375	16.0625	16.1250	16.1875	14.3750	14.4375	14.5625	14.6250
17	44.6875	44.8750	50.5000	214.2500	215.2500	15.9375	16.0625	16.1250	16.1875	14.2500	14.3125	14.4375	14.5000
18	44.3750	44.5625	50.2500	214.0000	215.0000	16.1250	16.1875	16.2500	16.3125	14.1875	14.2500	14.3750	14.4375
21	44.1875	44.3750	49.7500	213.7500	214.5000	15.8750	15.9375	16.0000	16.1250	14.0625	14.1250	14.1875	14.2500
22	43.8125	44.0000	49.5000	212.0000	213.0000	15.8125	15.9375	15.9375	16.0000	13.8750	13.9375	14.1250	14.1875
23	44.9375	45.1250	51.2500	215.7500	216.5000	16.3125	16.3750	16.3125	16.3750	14.1250	14.1875	14.2500	14.3125
24	45.2500	45.4375	51.2500	215.7500	216.6250	16.3125	16.4375	16.3750	16.4375	14.3125	14.3750	14.4375	14.5000
25	45.0625	45.2500	51.2500	216.0000	217.0000	16.3125	16.3750	16.3750	16.4375	14.1250	14.2500	14.2500	14.3125
28	43.5625	43.8125	49.0000	214.5000	215.2500	15.8125	15.8750	15.8750	15.9375	13.7500	13.8750	13.8750	13.9375
29	43.4375	43.6250	49.0000	214.5000	215.2500	16.0000	16.0625	15.9395	16.0000	13.6875	13.8125	13.8125	13.8750
30	43.6875	43.9375	49.0000	215.2500	216.1250	15.9375	16.0625	16.0000	16.0625	13.9375	14.0000	14.0000	14.0625
Average for month	45.244	.....	51.080	213.909	.....	16.088		16.223		14.366		14.550	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Dec. 1, 1938)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb ..... 20c.
Antimony, domestic, spot, lb 12.250
Bismuth, ton lots, lb $1.05
Cadmium, lb ..... 60@85c.
Calcium, lb., ton lots 97 @ 98 per cent ..... 75c.
Chromium, 97 per cent grade, lb ..... 85c.
Nickel, electrolytic cathodes, lb ..... 35c.
Magnesium, 99.8 per cent, carloads, lb ..... 30c.
Palladium, troy oz $24.00
Platinum, (Official quotation) troy oz $34.00
Quicksilver, flask of 76 lb., 100 flasks or more ..... $76.00@$78.00
Radium, mg. radium content $40.00
Selenium, 99.5 per cent, lb $1.75
Silicon, minimum 97 per cent, spot, lb ..... 16.50c.
Tellurium, lb $1.75
Thallium, 100 lb. or more, lb $6.50
Titanium, 96 to 98 per cent, lb $5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton ..... $30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton ..... $22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:
- Old Range bessemer $5.25
- Mesabi bessemer $5.10
- Old Range non-bessemer $5.10
- Mesabi, non-bessemer $4.95

Lead (Galena) 80 per cent, Joplin, Mo., ton $57.98
Manganese Ore, c.i.f. Atlantic ports, long ton unit:
- 52 @ 55 per cent ..... 30c.
- 50 @ 52 per cent ..... 27@30c.
- 44 @ 48 per cent ..... 25c.

Molybdenum Ore, 90 per cent, per lb. of contained MoS_2 ..... 45c.
Tungsten Ore, per unit of WO_3:
- Chinese, 65 per cent, duty paid $19.00
- Domestic, 65 per cent and upward ..... (a)$17.00@$19.00

Vanadium Ore, per lb. of contained V_2O_5 ..... 27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton. $33.00
(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb 3c
Cobalt Oxide, 70 @ 71 per cent, lb ..... $1.67@$1.77
Copper Sulphate, 100 lb $4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb $1.42
Sodium Sulphate, bulk, ton ..... $13.00@$15.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be $23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb ..... 10½c.
Ferromanganese, 78 @ 82 per cent, gross ton $92.50
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo contained. 95c
Ferrosilicon, 50 per cent, gross ton $69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained $1.60

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:
- Canadian (Quebec)
  - Crude No. 1 ..... $700@$750
  - Crude No. 2 ..... $150@$350
  - Spinning fibers ..... $110@$200
  - Paper stock ..... $40@$45
  - Shorts ..... $12@$16.50
- Vermont
  - Shingle stock $57
  - Paper stock $40
  - Cement stock $25

Barytes, long ton:
- Georgia, crude $7.00
- Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron ..... $6.00@$7.00

Bauxite, long ton:
- Domestic, chemical, 55 @ 58 per cent ..... $6. 0@$7.50
- Domestic, abrasive, 70 @ 84 per cent ..... $12.50@$15.00
- Dalmatian, 50 @ 55 per cent ..... (a)$6.50@$7.50
- French, 56 @ 59 per cent ..... (a)$7.50@$8.50

China Clay, f.o.b. mines, ton:
- South Carolina and Georgia, No. 1, bulk ..... $6.75@$8.00
- Delaware, No. 1 ..... $14.50

Feldspar, bulk, ton:
- Potash feldspar, 200 mesh $17.00
- Glass-spar, white, 20 mesh $11.75

Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton $18.00
Fuller's earth, f.o.b. Georgia or Florida, ton ..... $7.00@$14.00
Magnesite, per ton:
- Dead-burned, f.o.b. California $25.00
- Dead-burned, f.o.b. Washington $22.00

Mica, per lb., North Carolina, No. 1 and 2 quality:
- 1½ x 2 in ..... 15@40c.
- 2 x 2 in ..... 30@60c.
- 3 x 3 in ..... 75@$1.20
- 3 x 4 in ..... $1.00@$1.40
- 4 x 6 in ..... $2.00@$2.50
- White, ground, 70 mesh, ton ..... $60.00@$80.00

Ocher, Georgia, ton ..... $19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports ..... (a) 12@12½c.
Silica, in bags, 325 mesh, ton ..... $18.00@$40.00
Sulphur, Texas mines, long ton $16.00
Talc, f.o.b. works, ton:
- New York, double air-floated, 325 mesh ..... $12.00@$15.00
- New Jersey, mineral pulp ..... $8.00@$10.00
- Vermont, extra white, 200 mesh ..... $9.00@ $9.50

Tripoli, Missouri, ton:
- 40 mesh, cream colored $14.50
- 200 mesh, cream colored $26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:
- Bessemer $21.50
- Basic $20.50
- No. 2 Foundry $21.00

Steel, base prices, Pittsburgh:
- Billets, gross ton $34.00
- Structural shapes, 100 lb $2.10
- Bars, 100 lb $2.25

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1937	1938	1937	1938	1937	1938
January	44.913	44.750	20.734	19.895	490.670	499.895
February	44.750	44.750	20.083	20.159	489.307	501.722
March	45.130	44.446	20.677	20.088	488.412	498.394
April	45.460	42.750	20.740	18.880	491.524	498.046
May	45.025	42.750	20.346	18.731	493.835	496.673
June	44.818	42.750	20.022	18.945	493.404	495.772
July	44.750	42.750	19.986	19.356	496.582	492.855
August	44.750	42.750	19.848	19.389	498.043	488.044
September	44.750	42.750	19.889	19.300	495.145	480.240
October	44.750	42.750	19.942	19.613	495.395	476.785
November	44.750	42.750	19.707	19.834	499.467	470.587
December	44.750	.....	18.835	.....	499.510	.....
Year	44.883	.....	20.067	.....	494.275	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1937	1938	1937	1938	1937	1938	1937	1938
January	12.415	10.198	12.112	9.908	51.497	41.387	56.288	45.387
February	13.427	9.775	13.828	9.525	59.225	39.597	64.013	43.563
March	15.775	9.775	16.590	9.496	72.339	39.772	76.167	43.582
April	15.121	9.775	14.692	9.443	62.506	39.306	66.614	43.408
May	13 775	9.375	13.999	8.801	61.118	36.668	63.684	40.852
June	13.775	8.775	13.492	8.500	55.696	35.235	61.409	39.417
July	13.775	9.585	13.817	9.573	56.412	39.744	62.807	44.405
August	13.775	9.900	13.926	9.844	57.143	40.591	63.595	45.909
September	13.530	10.028	12.984	9.943	52.989	41.864	58.966	47.148
October	11.838	10.760	11.207	10.713	45.384	45.646	50.619	51.190
November	10.797	11.025	9.850	10.569	39.321	45.244	44.023	51.080
December	10.006	.....	9.714	.....	39.946	.....	43.886	.....
Year	13.167	.....	13.018	.....	54.465	.....	59.339	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1937	1938	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	6.000	4.870	5.850	4.720	27.272	27.150	16.135	16.253
February	6.239	4.632	6.089	4.482	28.319	28.328	15.402	15.525
March	7.190	4.500	7.040	4.350	33.027	32.979	15.992	16.075
April	6.175	4.500	6.025	4.350	26.014	25.878	15.579	15.623
May	6.000	4.400	5.850	4.250	24.000	23.891	14.210	14.376
June	6.000	4.148	5.850	3.998	22.878	22.759	13.969	14.012
July	6.000	4.882	5.850	4.732	23.932	23.703	14.921	15.034
August	6.452	4.900	6.302	4.750	22.606	22.670	14.371	14.480
September	6.400	4 998	6.250	4.848	20.990	21.044	15.249	15.401
October	5.740	5.100	5.590	4.950	18.259	18.318	16.173	16.313
November	5.033	5.091	4.883	4.941	16.706	16.714	16.088	16.223
December	4.875	.....	4.725	.....	15.905	15.994	.....	.....
Year	6.009	.....	5.859	.....	23.326	23.286	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1937	1938	1937	1938
January	50.925	41.548	229.350	183.619
February	52.010	41.373	233.750	183.144
March	63.043	41.219	282.988	183.473
April	59.172	38.430	267.136	168.612
May	55.651	36.885	250.645	162.693
June	55.851	40.376	249.852	177.429
July	59.245	43.428	263.540	192.542
August	59.465	43.276	264.595	192.966
September	58.675	43.369	258.943	193.733
October	51.654	45.263	223.869	206.911
November	43.299	46.262	190.477	213.909
December	43.051	.....	190.449	.....
Year	54.337	.....	242.133	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	5.847	5.000	21.153	21.281	14.994	15.173
February	6.465	4.813	25.122	25.322	14.408	14.589
March	7.381	4.417	33.188	33.405	14.364	14.477
April	7.010	4.141	26.216	26.344	13.729	13.919
May	6.750	4.042	23.092	23.365	12.682	12.869
June	6.750	4.131	21.409	21.528	12.890	13.104
July	6.923	4.745	22.568	22.693	14.144	14.371
August	7.192	4.750	24.140	24.290	13.467	13.675
September	7.190	4.846	21.406	21.607	14.040	14.246
October	6.085	5.012	17.722	17.955	15.083	15.232
November	5.630	4.924	15.808	15.970	14.366	14.550
December	5.010	.....	15.274	15.429	.....	.....
Year	6.519	.....	22.258	22.432	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1937	1938	1937	1938
January	90.000	117.500	19.500	20.000
February	90.000	117.500	19.500	20.000
March	101.667	117.500	20.000	20.000
April	105.000	102.500	20.000	20.000
May	105.000	102.500	20.000	20.000
June	130.962	102.500	20.000	20.000
July	142.500	102.500	20.000	20.000
August	142.500	99.722	20.000	20.000
September	142.500	84 000	20.000	20.000
October	142.500	80.000	20.000	20.000
November	142.500	77.717	20.000	20.000
December	132.888	.....	20.000	.....
Year	122.335	.....	19.917	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium cents per pound, average of producer's and plater's quotations.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1937	1938	1937	1938	1937	1938
January	14.130	13.750	90.250	79.240	50.400	36.000
February	14.563	13.750	91.000	76.455	64.364	36.000
March	16.375	13.750	91.778	72.444	58.000	36.000
April	16.043	13.654	92.000	71.019	58.000	36.000
May	14.830	12.460	95.520	74.640	54.800	33.400
June	14.702	11.731	96.654	80.731	53.000	33.231
July	14.803	11.030	93.904	76.860	50.115	36.000
August	15.327	10.880	91.423	75.500	51.000	37.000
September	16.555	11.310	89.020	74 420	51.000	39.000
October	16.935	12.060	86.140	73.480	48.560	37.960
November	15.848	12.250	83.435	74.065	43.652	36.217
December	14.144	.....	81.038	.....	38.385	.....
Year	15.355	.....	90.180	.....	51.773	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1937	1938	1937	1938	1937	1938
January	21.50	24.50	20.50	23.50	21.00	24.00
February	21.50	24.50	20.50	23.50	21.00	24.00
March	24.20	24.50	23.20	23.50	23.70	24.00
April	24.50	24.50	23.50	23.50	24.00	24.00
May	24.50	24.50	23.50	23.50	24.00	24.00
June	24.50	23.73	23.50	22.73	24.00	23.23
July	24.50	20.50	23.50	19.50	24.00	20.00
August	24.50	20.50	23.50	19.50	24.00	20.00
September	24.50	20 50	23.50	19 50	24.00	20.00
October	24.50	21.50	23.50	20 50	24.00	21.00
November	24.50	21.50	23.50	20.50	24.00	21.00
December	24.50	.....	23.50	.....	24.00	.....
Year	23.975	.....	22.975	.....	23.475	.....

Iron in dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

What Metal Statistics Show

AS EMPLOYMENT reached a high for the year at mines and smelters in November, and producers looked forward to a healthy rate of operations during the winter, the outlook was suddenly obscured by the announcement on Nov. 17 that duties on imported zinc ores and metal had been lowered in the new trade agreement with Canada, effective Jan. 1, 1939. Zinc producers here soon felt the shock of lower prices, and since metal prices were dropping in London because of a jittery European political situation, domestic producers became apprehensive lest this unwieldy situation would depress the domestic price structure of other metals. Sales declined sharply in November, and with copper production increasing, here and abroad, nervousness appeared, indicating curtailment should be considered. On Nov. 23 the foreign group in the copper-control agreement announced that output will be stepped down from unlimited production (since Oct. 15) to 110 per cent of basic tonnages, effective Jan. 1, 1939. On Dec. 7, however, another change was made. From Dec. 15 to 31, production will be at 105 per cent and on Jan. 1, 1939, output will be at 100 per cent of rated capacity.

Domestic copper production for November is expected to show another increase, but since deliveries to consumers have been holding up well, the trade believes statistics should again show a moderate reduction in stocks of refined copper. Many observers believe metals will become more active after Jan. 1.

Following is a record of sales of copper in the domestic market, by months, for 1936, 1937, and the first eleven months of the current year, in short tons:

	1936	1937	1938
January	33,165	53,819	25,543
February	78,654	74,912	23,518
March	35,948	53,101	22,012
April	158,064	26,143	22,790
May	16,303	43,130	18,853
June	16,521	35,395	87,730
July	175,484	62,298	124,054
August	25,253	69,225	23,195
September	40,769	28,936	62,232
October	178,801	23,238	78,288
November	88,177	21,035	12,524
December	117,715	26,504	.....
Totals	964,854	517,736	.....

The Copper Institute's figures for September and October, in short tons, follow:

	Sept.	Oct.
Production, crude:		
U. S. mine	41,116	54,446
U. S. scrap, etc.	8,200	15,159
Foreign mine	83,092	101,602
Foreign scrap	13,749	13,870
Totals	(a)146,157	185,077
Production, refined:		
U. S. duty-free	45,808	56,824
Foreign	108,057	110,401
Totals	153,865	167,225
Deliveries to customers, refined:		
U. S. domestic	53,637	69,827
U. S. exports (b)	14,282	12,778
Foreign	123,016	117,363
Totals	190,935	199,968
Stocks at end, refined:		
United States	293,080	267,299
Foreign	164,374	157,412
Totals	457,454	424,711

(a) Revised. (b) Duty-free copper.

▶ LEAD—Production of lead in October as shown in the accompanying table was not as great as first anticipated by the trade. During November, however, two more smelters, East Helena, in Montana, and at Murray, Utah, were in operation, and production from domestic ore, in some cases accumulated during smelter shutdown, is expected to show a substantial increase. Shipments to consumers in October made a new high for the year and a slightly less total is expected in November; therefore, another decrease in stocks of refined lead is anticipated. Actual consumption of lead is estimated to be about 40,000 tons per month. Sales of lead dropped on November, and with little business expected in December, the smelters faced an intake problem which probably accounts for the decision to lower the price on Nov. 29 and again on Dec. 8, 10 and 15 points respectively.

The September and October figures on refined lead, in short tons, are summarized as follows:

	Sept.	Oct.
Stock at beginning	142,868	131,353
Production:		
Domestic ore	24,994	27,968
Secondary and foreign	2,514	3,875
Totals	27,508	31,843
Domestic shipments	39,926	45,726
Stock at end	131,353	117,476

The following tabulation shows total lead stocks at the works of smelters and refiners in the United States so far as reported, in short tons:

	Oct. 1	Nov. 1
In ore, matte, process (a)	60,489	60,200
In base bullion:		
Smelters and refiners	9,749	10,567
In transit to refineries	1,422	1,709
In process at refineries	13,762	13,942
Refined lead	119,987	108,130
Antimonial lead	11,366	9,346
Total stocks	216,775	203,894

(a) At smelters.

▶ ZINC—The October and November statistics of the American Zinc Institute, covering all grades, are summarized as follows in short tons:

	Oct.	Nov.
Production	36,740	40,343
Production, daily rate	1,185	1,345
Shipments	43,355	43,693
Stock at end	124,128	120,778
Unfilled orders	40,736	40,280

Statistics of the Prime Western division, common grades only, for October and November, follow:

	Oct.	Nov.
Stock at beginning	52,210	50,132
Production	15,833	17,013
Shipments	17,911	19,842
Stock at end	50,132	47,303

Copper Production Outside of United States

(American Bureau of Metal Statistics)

Production of copper in the world from ore originating outside of the United States, on smelter basis, in short tons, is given below. Estimates for Russia and Japan are conjectural, as precise information is not available. Advices from Moscow indicate that production in the Urals has been increasing. Smelting of some Canadian ore in Japan, apart from domestic production, points to a gain in output for Japan.

	Third Quarter 1937	Fourth Quarter 1937	Year 1937	First Quarter 1938	Second Quarter 1938	Third Quarter 1938
U. S. foreign ore (a)	19,600	19,400	68,400	16,500	16,200	16,600
Mexico (b)	13,600	9,700	49,100	9,000	11,000	9,500
Canada	56,400	62,500	227,300	62,100	60,400	62,800
Chile	97,400	98,700	437,000	90,700	90,800	82,500
Peru	9,600	9,600	37,600	10,200	9,900	9,500
Germany	18,200	18,200	71,600	17,600	18,200	17,600
Russia	(f) 26,000	(f) 26,000	(f) 102,000	(f) 26,000	(f) 30,000	(f) 30,000
Yugoslavia	11,500	11,200	43,100	11,900	12,000	12,900
Other Europe (c)	12,000	13,800	53,900	14,000	15,600	16,000
Japan (d)	24,600	25,100	96,600	(f) 25,500	(f) 27,000	(f) 30,000
India	2,000	2,000	7,600	1,600	700	1,700
Other Asia	300	300	4,500	1,200	1,200	1,500
Australia	5,300	4,700	18,300	4,700	4,700	5,400
Africa (e)	98,700	97,800	411,400	92,600	93,700	86,600
Totals	395,200	399,000	1,628,400	383,600	391,400	382,600
Monthly average	131,733	133,000	135,700	127,867	130,467	127,533
Daily average	4,296	4,337	4,461	4,262	4,301	4,159

(a) Copper content of ore and matte imported at 95 per cent, including receipts from Cuba admitted duty free. (b) Imports of blister copper into the United States from Mexico, except that the total for 1937 is the reported production. (c) Partly estimated; includes Finland, Great Britain, Spain, France, Norway, Sweden, Italy, Rumania, and Belgium ex-Katanga; copper from Katanga matte smelted in Belgium is credited to Africa. (d) Refined copper. (e) Comprises Belgian Congo, Rhodesia and Union of South Africa. (f) conjectural.

NEVADA

Lucky Boy Silver-Lead Mine Rehabilitated

Option to purchase property acquired by Duluth interests—Two compartment shaft to be sunk at Dan Tucker mine—Gold properties in Douglas district examined

▶ An option to purchase the Lucky Boy silver-lead mine, near Hawthorne, Mineral County, has been acquired by Capt. K. E. Harris, of Duluth, Minn., and associates from John H. Miller, of Hawthorne. A deep-level, 6,600-ft. drainage and transportation tunnel has been reopened and repaired to the 2,900-ft. point and the 1,200-ft. Hubbard shaft has been reconditioned.

▶ Caving earth and loose surface rock on the east face of Cedar Hill, at the north end of the Comstock lode, recently released an estimated 500,000 tons of overburden that partly filled the large open cut of the Sierra Nevada, Ltd., covering a large part of the low-grade orebody from which power shovels have been supplying the company's 400-ton flotation mill. Ore is available also through a series of tunnels, and interruption to milling was not greatly prolonged. Arthur Thomas is president, and A. Blake Thomas, manager.

▶ The old Rocky Hill mine, in Washoe County, has been acquired under option by J. O. Greenan and N. H. Getchell, who have organized the Gold Trail, Inc., to develop further the gold-silver property owned for many years by A. M. Keefer, of Reno. An old tunnel has been reopened, exposing a long shoot of ore of high mill grade. A compressor and other equipment have been installed. Debs Longero is superintendent.

▶ Seams of copper ore sampling up to 32 per cent are reported exposed in a winze sunk 70 ft. from a 175-ft. tunnel on property of the Mountain City Consolidated Copper Company, adjoining the Rio Tinto mine of the Mountain City Copper Company in northern Elko County. Pat Mooney, secretary-treasurer, has purchased for the Mountain City Consolidated the surface plant of the Fulton Quicksilver Company in Humboldt County, including diesel power plant, generators, four-drill compressor, pumps and 5,000-gal. fuel tank. George B. Thatcher, of Reno, is president and M. E. Bohannan is manager at Mountain City.

▶ A contract has been awarded to sink a two-compartment shaft on the Dan Tucker mine, 30 miles east of Fallon, in Churchill County. The gold-silver property, productive of high-grade ore at intervals for a long period, has been acquired under option by Ira B. Joralemon, of San Francisco. George Fraser, of Fallon, is in charge of operations.

▶ Mountain City Copper Company is now shipping around 200 tons per day of concentrate and high-grade copper ore by trucks to Elko and thence by rail to the International smelter in Utah. J. O. Elton, president of the Mountain City Copper Company, had stated that resumption will be conditional on a pledge that the Elko-Mountain City road would be kept open to trucking during the winter months. Around 300 men are employed under the direction of J. J. Lillie, manager at Rio Tinto.

▶ Engineers acting reputedly for an Eastern group have been examining large gold properties owned by H. E. Springer, of Mina, and situated in the Douglas district, southwest of that town. From several leases in this area trucks have been delivering around 40 tons per day to the custom mill of the Dayton Consolidated Mines Company, near Silver City, a haul of about 180 miles.

▶ October production from the cyanide mill operated by Greenan & Company, Inc., in Mill Canyon, Eureka County, was $27,000 in gold bullion from 915 tons of ore. With added equipment the mill is now treating 40 tons per day. Recent underground work has yielded good results, and with continued additions to the reserve a 75- or 100-ton cyanide plant will be provided. J. O. Greenan, First National Bank Building, Reno, is president and manager.

CALIFORNIA

Large Cyanide Plant Begins Operations at Stent

Gertrude Mining Exploration Company starts production from 1,000-ton mill—Yellow Aster mine raises output—Lava Cap Mining Corporation now shipping concentrates to Selby smelter

▶ Designed to handle 1,000 tons of ore a day, the new cyanide plant of the Gertrude Mining Exploration Company, at Stent, Tuolumne County, recently started operations. Equipment comprises six 400-ton leaching tanks, a Merrill-Crowe precipitation plant, and auxiliary units. The plant is a short distance from the mill proper, which has facilities to crush and grind about 1,200 tons of ore a day. Gold-bearing material mined from a surface deposit by power shovels is hauled to the mill by tractors. J. S. Cadamortari is superintendent, and about twenty men are employed.

▶ Columbia Star Gold Mines, Inc., organized recently by Eastern and Nevada interests, has announced plans for development of the German, Columbia, and Ocean Star properties near Washington, Nevada County. A small pilot mill is to be erected, which will be replaced with a larger unit as soon as additional ore has been developed. E. R. Berg, with headquarters at Reno, Nev., is president.

▶ The old Mammoth King mine, near Washington, Nevada County, rehabilitated recently by J. M. Hoff, is now producing around 40 tons of ore a day. The ore is trucked to the Gracey Glencoe mill, at Nevada City, for treatment. Eleven men are employed.

▶ Mining operations are in progress at the Mayflower mine, near Forest Hill, Placer County, leased recently to the Ish, Trippe, & Algard Company, of Detroit, Mich., by the Mayflower Gravel Mining Company. The old shaft has been rehabilitated to the upper streak of the old Paragon vein, and a 150-ton mill is ready for operation. George Duffy, superintendent, is in charge of operations.

▶ B. L. Melville is reported to have sixteen men employed in testing, by core drilling, several hundred acres of probable placer ground between North Columbia, Cherokee, and Tyler, on the San Juan Ridge in Nevada County, for the possible installation of dragline dredges.

▶ A 50-ton mill is rapidly nearing completion at the Young America mine, near Sierra City, Sierra County. Underground, the tunnel driven from the old No. 4 lateral is advancing steadily in virgin territory, with ore values improving. The property is operated by J. J. McDonald, and C. H. Vail is in charge of operations.

▶ According to a report from Placerville, R. J. Wilson, operator of the noted Black Oak mine, at Garden Valley, El Dorado County, has completed arrangements with the Lode Development Company for the treatment of ore mined from the Spanish Oak mine, near Kelsey, in the 100-ton mill at the Rosencranz property, near the Black Oak. Ore-dumping and storage facilities are now being erected at the Rosencranz mill, which will treat Spanish Oak ore on a one-shift basis for twenty days of the month. E. M. Cooper, superintendent, directs operations both at the Black Oak and Spanish Oak properties.

▶ To remove itself from the jurisdiction of N.L.R.B., the Lava Cap Gold Mining Corporation, operating the Banner and Central mines, near Nevada City, has discontinued sending concentrates produced at the 300-ton mill to the Tacoma smelter, and instead is shipping them to the Selby reduction works of the American Smelting & Refining Company, which automatically changes the status of the company from that of an interstate to an intrastate operation, according to the recent Idaho Maryland ruling. Otto E. Schiffner is general manager of the corporation.

▶ Production has been increased from 2,100 to 4,000 tons a day at the Yellow Aster mine, with the Macco Construction Company under contract for removing some 6,000,000 tons of low-grade gold ore from open-pit workings, adding a second shift of nine men to the regular working force. All ore removed from underground and open-pit operations is first treated in the new 2,000-ton crushing and screening unit, then concentrated in a 500-ton mill, and subsequently cyanided in the 1,200-ton plant, which also handles old tailings. The Yellow Aster mine, a short distance from Randsburg, is operated by the Anglo American Mining Corporation, Ltd., with Walter Lyman Brown, of San Francisco, president, and A. W. Frolli, general manager, in charge of operations.

▶ At the Comanche mine, near Benton, Mono County, C. W. Jones and associates have completed a 100-ton mill to handle both company and custom ores. The property is controlled by the Co-

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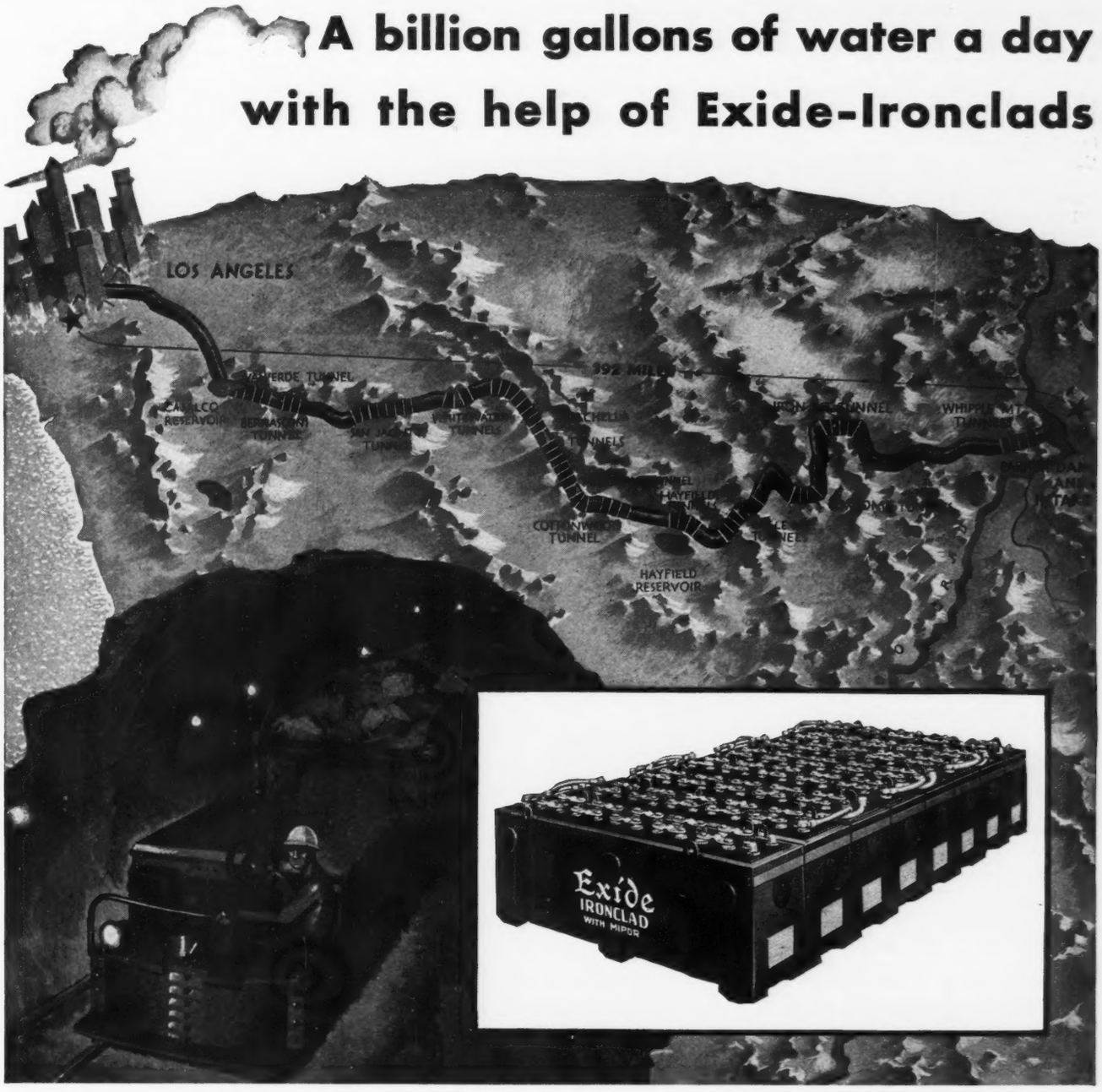

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▶CALIFORNIA

manche Mining & Reduction Company, of which G. W. Adams, of Los Angeles, is president.

▶ Preparations for early mining operations are in progress at the Paragon hydraulic mine, in the Forest Hill area, Placer County, leased recently by W. A. Wilson, of Redding, Calif., and associates. The property was worked for some time by the King C. Gillette interests of Hollywood. Development plans include sinking of a shaft in the center of the present pit to reach the sluice tunnel. Construction of the North Fork debris dam, near Auburn, has made unnecessary replacement of the private dam washed out by floods during the Gillette management.

ARIZONA

New Cyanide Mill Near Kirkland Planned

Plant will have 100-ton capacity—More furnaces blown in at copper smelters—Golden Eagle custom plant completed

▶ Preparations are being made for construction of a 100-ton cyanide plant at the property of the Hassayampa Gold Mining Company, near Kirkland, which is owned by E. W. Nelson, of Kirkland.

▶ Equator Mining Company is operating the old Equator mine, near Cottonwood, also known as the Iron King. It is shipping 300 tons of ore per month. The property is under lease from the Phelps Dodge Corporation.

▶ A second furnace has been blown by the Phelps Dodge Corporation at Clarkdale. A crew of 575 men is employed at the plant. William Saben, of Clarkdale, is manager.

▶ Two lessees of the Silver Cord Mining Company, at Cleator, are each shipping a carload of ore per month. James P. Cleator, of Cleator, and H. C. Warmout, of Bumblebee, are the lessees.

▶ Gold Standard mine, at Katherine, has taken over the Tyro property, about six miles from the mill. The Tyro was a former shipper of ores to the Katherine mill. I. M. George, of Kingman, is the owner of the property.

▶ The flotation plant of the Golden Turkey Mining Company, at Cordes, is operating steadily and shipping concentrates to the El Paso smelter. A crew of 40 is employed. H. C. Mitchell, of Cordes, is general manager of the company.

▶ Albatross Gold Mines, Inc., of Arivaca, recently completed a geophysical survey of their property. The company plans the installation of a crusher and concentrating tables, and production is expected soon. Several ore lenses of importance have been opened in the tunnel now being driven. E. LeRoy Blessing, president of the company, is in charge of operations.

▶ The new custom mill of the Golden Eagle Milling Company, at Cherry, is completed and custom ores are now being received for treatment. The plant is equipped with a 25-ton ball mill and amalgamation tables. Roy Cornett, of Dewey, is operating the mill.

▶ Golden Aster mine, at the head of Castle Creek, is being operated under lease by R. L. Marshall, of Yava. A mill is being planned for the property, which is owned by Mrs. E. L. Champie, of Castle Hot Springs.

▶ Vesuvius Mining Company, at Kirkland, is developing the Vesuvius mine with a crew of ten men. The ore is being milled in the 25-ton flotation plant on the property. Dr. A. W. Lindberg and Harry Galloway are carrying on the work.

▶ Golden Crown Mining Company is developing the Crown King mine, at Crown King. W. L. Simon is general manager.

▶ The Hart mine, near Cibola, is being operated by a crew of ten men under the direction of Eugene B. Hart. The work is being carried on by an RFC Class B mine loan totaling $8,000.

▶ The 50-ton flotation plant at the Yarnell mine is operating at capacity under the direction of Mark Gemmell, of 325 East Portland St., Phoenix. Fifteen men are employed.

▶ The Arluck lease on the Octave mine, at Octave, is shipping twenty tons of ore daily to the Octave mill of the American Smelting & Refining Company. A. A. Arluck is in charge.

▶ D. R. Manning, of Wickieup, and R. Carleton, of Chloride, owners of the Echo group of mining claims in the Hualapai Mountains south of Cedar Valley, are doing considerable development work and expect to commence shipping ore soon.

▶ A small tonnage of high-grade ore is being milled in the plant recently installed on the Dead Bull mine, near Oracle. R. L. Oliver, of Oracle, is directing operations.

▶ The Black Range Annex, located about two miles southeast of Boundary Cone in the Oatman district, Mohave County, has been bonded for $50,000. Exploration work is expected to commence soon. Pete Ileson holds the option from the Dave Wright estate.

▶ A fourth furnace has been placed in operation at the Copper Queen smelter of the Phelps Dodge Corporation at Douglas. About 950 men are employed at the smelter. H. M. Lavender, of Douglas, is manager.

▶ The Clara mine, near Swansea, owned by S. J. Curtis, of Bouse, is being operated under lease by C. S. Cory. The values are in copper-gold averaging $25 per ton. Ore shipments have already been forwarded to the smelter.

▶ The Bi-Metal mine, three miles southwest of Kingman, is shipping 300 tons of gold ore monthly to the Tom Reed mill, at Oatman. Claude Wilkinson is managing the property under option.

▶ A 30-ton mill has been completed at the Townsend mine, on the Bill Williams River in southern Mohave County, and is now treating ore. James C. Townsend, 5001 East Fourteenth St., Long Beach, Calif., is president of the company and in charge of operations.

▶ The Tennessee-Schuykill operations at Chloride are handling 200 tons of ore through the company's flotation plant daily. Some of this is custom ore. About 100 men are employed. Jacob Schoder, of Chloride, is general manager.

COLORADO

Gold Output Expected to Show Gain for Year

Several counties indicate substantial increases in production over figures for 1937—Aerial tramway at Veta Mines nears completion—Mill capacities at some properties are enlarged

▶ Charles W. Henderson, field supervising engineer of the United States Bureau of Mines at Denver, states there will be no decrease in the State's output of gold, silver, and copper during 1938, but lead and zinc will probably decline because of low metal prices during the current year. Some of the reasons for his statement are: the Sunnyside 1,000-ton mill operated longer in 1938 than in 1937, which will help the totals in some of the base metals; the Chain-O-Mines produced less in 1938, but at the A.S.&R. property at Alice, the 250-ton mill operated ten months during the year; and with the possible exception of Pitkin, Gilpin, Summit, Lake, and Dolores counties, all other counties will probably maintain or exceed their 1937 production. Boulder, Eagle, and Teller counties show good increases; and Clear Creek, Ouray, and San Miguel counties show only slight gains. The United States Vanadium plant at Uravan, Montrose County, ran the 260-ton mill continuously throughout the year.

▶ C. M. Glasgow, general superintendent of the Veta Mines, Inc., states that the new tram line from the Pennsylvania tunnel to the mill is nearing completion. The ore bin is now of sufficient size to permit mill operation in case of transport delay due to bad weather. Mill capacity has been increased. A large Marcy ball mill, a Dorr classifier, and a new six-cell Denver Sub-A flotation cell have been installed. John Ferguson is mill superintendent, and R. H. Sayre, of Denver, is president.

▶ Butterfly Consolidated Mines plans enlargement of the company's mill at Telluride, according to Walter Binner, manager. The new addition will enable the organization to operate two separate circuits, and will include classifier, tables, a Marcy ball mill, flotation machines, filter, and complementary apparatus. The ore occurs in diorite-monzonite fissure veins, averaging 3½ ft. wide, and assaying $6 to $18 per ton in gold, silver, lead, and copper. Considerable development work has been done on the No. 3 level, and a highly mineralized vein has been cut in the Butterfly-Terrible ground, adding to ore reserves.

▶ Operations at the new Cameron 100-ton flotation mill at Cripple Creek indicate that recovery averages about 92 per cent. Mill heads contain about 0.12

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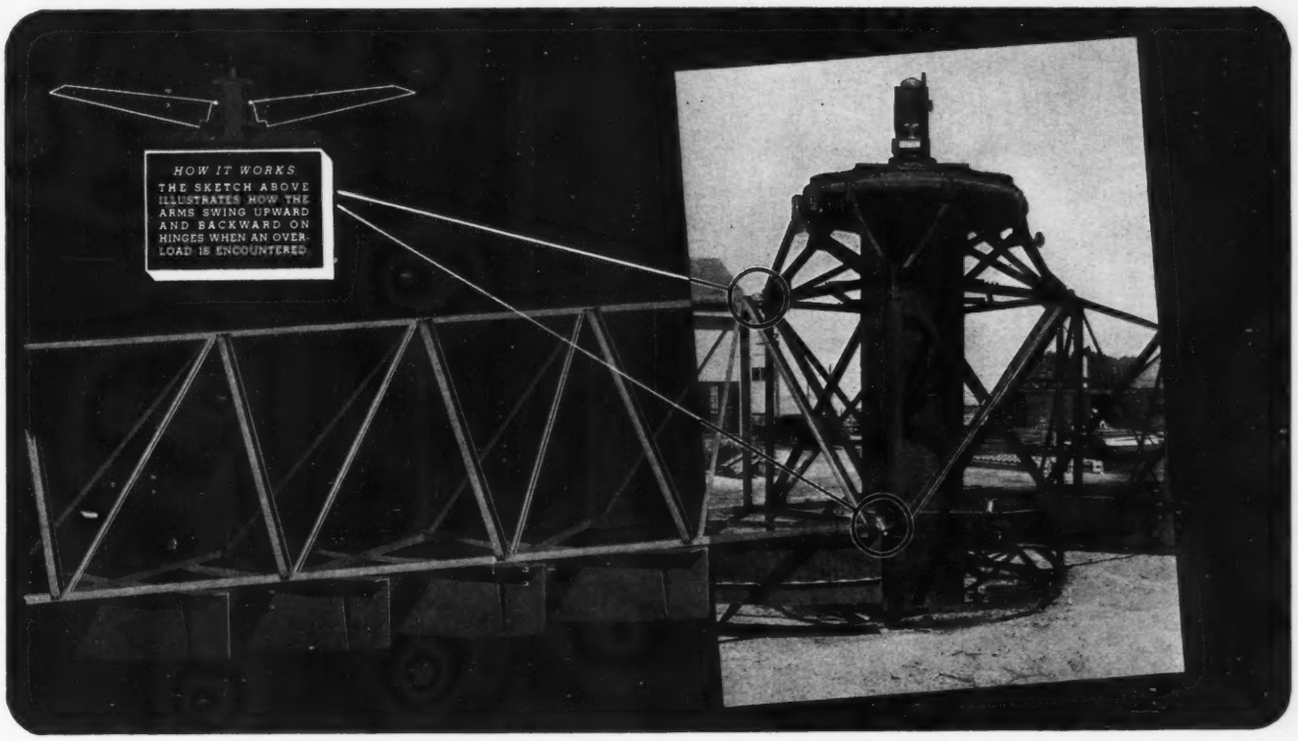
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▶COLORADO

oz. gold. The Cameron plant is considered one of the best in this section. All mill equipment is on one floor, permitting simple operation. New equipment installed consists of a Denver Sub-A flotation machine, an ore-feeder, a Denver classifier, Marcy ball mill, Telsmith Wheeling crusher, several Wilfley pumps, Stilphen unit heaters, and a Scoby-type samplers. Walter O. McClintock is mill superintendent.

▶ On the proposed Cripple Creek drainage tunnel, it has been suggested that the WPA furnish all labor and the mine operators furnish the supplies and material. A. H. Bebee, superintendent of the Carlton interests, is favorable to the plan and expects to confer with the county commissioners on details of the work and the number of men available in the district.

▶ Triple T Mining Company has ordered a large crusher, a Caterpillar tractor, and dragline for the Hoffman-Jefferson mines, on Crooked Gulch, in Saguache County, near Crestone, Colo. E. L. Knickerbocket is superintendent and J. H. Triplett, of Carthage, Mo., is president.

▶ Work on the new Rico-Argentine mill is progressing nicely and if weather conditions permit, this plant is expected to be completed in February.

▶ Using an air-lift pump, the New Elkhorn shaft at Leadville, is being unwatered. Water is being pumped in this manner to the 200-ft. level, where centrifugal pumps bring it to the surface. The shaft has been unwatered to the 317-ft. level. R. T. Walker, well-known geologist and mining operator, is doing this work for the purpose of obtaining sufficient data to determine the future direction of the Canterbury tunnel, the face of which is about 6,000 ft. northwest of the New Elkhorn.

▶ The Cloverdale Mines Company, near Westcliffe, have opened up a vein of high-grade ore, and after fifteen years of steady development work, made a producer. A. P. Smith is president and W. B. Porch is mine manager.

▶ Two new duralumin skips, one for the Dooley Leasing Company and the other for Cameron mine were recently installed at the respective mines. These skips made by the Vulcan Iron Works, Denver, are said to be about 600 lb. lighter than those formerly used made of steel and iron.

▶ In the Montezuma section, Walter Head has installed a new air compressor on the New York, and plans to increase ore shipments to the St. John's mill. George Goodman is reported to have opened up 3 ft. of ore in the Bullion mine. Johnson & Associates have remodeled the Colorado Toledo mill, and will soon be ready for treating custom ore.

▶ The newly organized Gregory-Bobtail Mining Company has taken over the holdings and equipment of the Gregory-Bates Mining Company, which, under the direction of Robert M. Wheeler, is being made ready for operation. Stamp batteries have been discarded and a new Marcy mill has been installed.

Annual Meeting of Air Hygiene Foundation

▶ More than 200 executives from 101 industrial concerns attended the third annual fall meeting of Air Hygiene Foundation held at Mellon Institute, Pittsburgh, on Nov. 17. Executives heard reports on latest advances in protecting the health of industrial workmen who lose an estimated 200 million working days yearly because of illness.

In addition to the technical discussions, speakers stressed the broad benefits for management, labor, and the community resulting from this collective effort by employers toward improving health in industry.

Among those who spoke, with some of the addresses, were: Dr. Willard E. Hotchkiss, Maurice Falk professor of Social Relations, Carnegie Institute of Technology, who discussed "Social Aspects of Industrial Health." Philip Drinker, chairman, Preventive Engineering Committee, spoke on "Engineering Progress Toward Further Protection of Industrial Health." T. F. Hatch, New York State Division of Industrial Hygiene, discussed "State Codes for Control of Industrial Health." Dr. Leroy U. Gardner, director, the Saranac Laboratory, gave a report on "Further Researches on 'Mixed' Dusts and 'Protector' Dusts." The program included findings from researches which are being conducted under grants from Air Hygiene Foundation.

IDAHO

Old Lincoln Mine in Pearl District, Dewatered

Property will be prospected by diamond drilling—Plant capacity increased at the Mayflower mine—Good ore found at Lucky Friday and Coeur d'Alene mines

▶ The famous old Lincoln mine, a large producer for many years in the Pearl district of Gem County, is being revived by Eastern owners. The property, now known as the Huron Mines, Inc., is owned by the Manufacturers Trust Company, New York, which is represented at Emmett by J. L. Fozard, of New York. The shaft has been pumped out and a crew of seven men has been working on a three-shift basis. A diamond-drill outfit, complete with hoist and all equipment for core explorations, is at the mine.

▶ Addition of another ball mill at the Mayflower mine of the Texas-Owyhee Mining Company at Quartzburg has increased the capacity of the plant to between 150 and 160 tons daily, according to H. C. Murphy, of Boise, manager. With a crew of 80 men the Mayflower is now the largest lode operation south of the Salmon River. Recovery from the complex ore has been averaging better than $7 a ton. The company is paying its crew time and one-half for the sixteen hours they work over the 44 hour limit set by the wage-and-hour law.

▶ Silver Summit, in the Coeur d'Alene district, will crosscut to its vein from the 600-ft. shaft level as soon as station facilities can be completed, according to Harry P. Pearson, of Wallace, manager. Both the Sunshine and Polaris vein systems are in the Silver Summit ground on their eastward extension. Distance to the vein from the 600 level is estimated at 480 ft.

▶ The vein in the west drift of the Coeur d'Alene Mines Corporation, in the Coeur d'Alene district from the 1,000-ft. shaft level, has widened to 9 ft., carrying ore running 10 to 15 oz. of silver with streaks of high grade reported running as high as 500 oz. to the ton. Ore is being hauled to the Hercules mill, at Wallace, for treatment.

▶ Pine Creek Lead-Zinc Mining Company stockholders met in Seattle on Dec. 5. to increase capitalization from $100,000 to $200,000 by the authorization of 100,000 shares of 6 per cent non-cumulative preferred stock with $1 par value. The company owns a modern flotation milling plant at its property on Pine Creek, but has been idle for a number of years owing to low zinc prices. H. G. Beal, of Seattle, is secretary.

▶ Work has been resumed at the North Bunker Hill property, in the Wardner district. The lower tunnel has been retimbered and the shaft is being unwatered with plans to crosscut to the vein from the 300-and 500-ft. levels. N. T. Hardy, of Kellogg, is president.

▶ Eighteen to twenty inches of high-grade silver ore is reported at the Lucky Friday mine, at Mullan, according to John Sekulic, of Mullan, who has a five-year bond and lease on the property. The ore assays from 40 to 300 oz. of silver. It is being hand-sorted and will be shipped by truck to the Bunker Hill smelter, at Kellogg.

▶ Big Buffalo mine, in the Elk City district, bought a year ago by William B. Fryberger, of Duluth, Minn., for $150,000, will be explored by 5,000 ft. of diamond drilling.

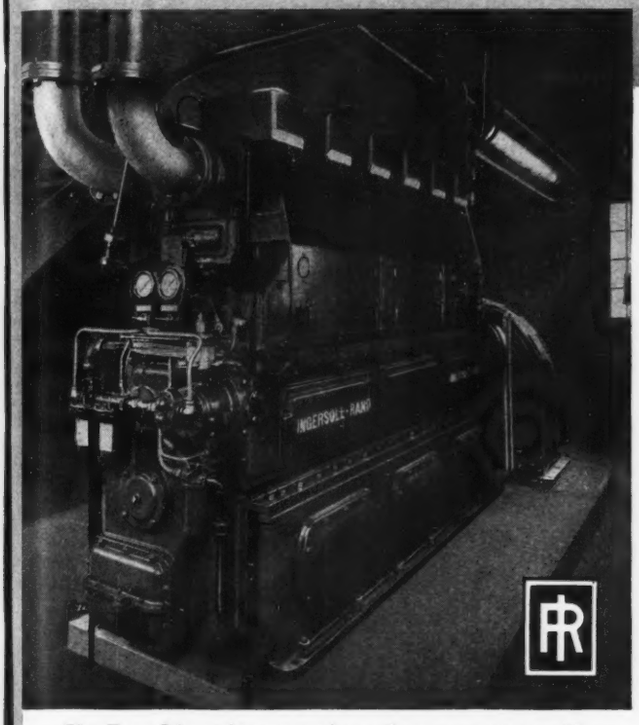
▶ The mill of the Gold Producers, Inc., at Shoup, Lemhi County, is now handling 90 to 100 tons daily from the Gruenter mine. It is estimated that 300,000 tons of milling ore are available. Concentrates are being shipped to Salt Lake. Lawrence L. McLean, formerly of Colville, Wash., is manager.

▶ Owners of stocks in mines of the Coeur d'Alene district have received dividends totaling $3,091,192 during the first ten months of the current year. Of this amount the 6,500 stockholders in the Sunshine Mining Company have received the bulk of $2,679,876, in three quarterly disbursements. Owners in the Polaris, the district's newest producer, have benefited to the amount of $220,000. Hecla has paid $150,000. Jack Waite joined the list this year with a payment of $41,316.

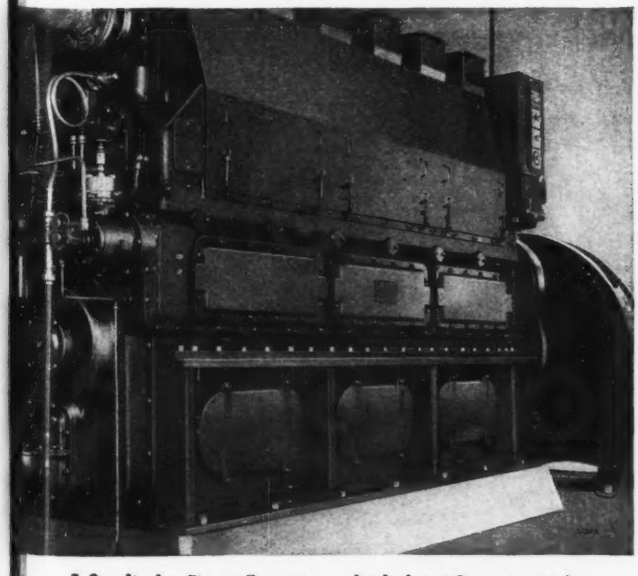
▶ The Clayton mine, in Lemhi County, shipped concentrates during September and October that showed a net value of $16,994.28, obtained from four cars of ore, averaging 94.14 oz. silver and 65.68 per cent lead. Net value per ton was $99.63. Mining costs for the nine months of 1938 averaged $1.08 per ton, and milling, $1.04 per ton, for a total of $2.12 per ton.

The TYPE "S" HEAVY-DUTY DIESEL ENGINE

IDEAL FOR MINE SERVICE because



This Type S furnishes power for a silver concentrate mill.

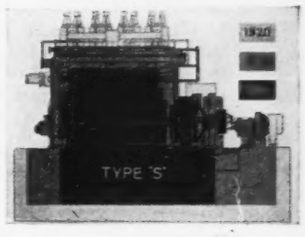


A 6-cylinder Type S engine which furnishes power in a gold mine.

IT IS EASY TO TRANSPORT

Engines can be shipped by truck, fully assembled. The 460-hp. size weighs 12 tons, and the 175-hp. size 6½ tons. For airplane transportation or movement over steep, mountainous roads, all engines can be shipped disassembled, making the maximum weight of the heaviest piece 2½ tons on the largest engine.

COMPACT AND EASY TO INSTALL



Rigging expense, building costs and size of foundation are reduced because the Type S is compact, comparatively light in weight and usually shipped fully assembled.

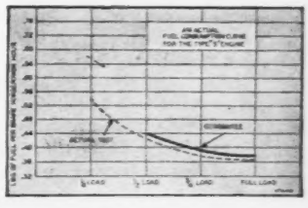
EASY TO OPERATE

Because nothing has been omitted that would aid in reliability, safety and ease of operation, an experienced operator is not required.

RELIABLE

The Type S is rated and built for continuous full-load service. 65,000 horsepower of Ingersoll-Rand, 4-cycle, 10" x 12" engines in service today prove its reliability.

ECONOMICAL TO OPERATE



The extremely low fuel consumption of the Type S engine—.38 lb. per b.hp.-hr. —is equal to that of the very largest Diesels.

EASY TO SERVICE AND MAINTAIN

Full force-feed lubrication, and precision-type shell bearings which eliminate "scraping in", reduce bearing maintenance. Small parts are easy to handle, accessible and inexpensively replaced. Many maintenance jobs are eliminated because of the high efficiency of the Type S combustion system, the controlled, high-velocity cooling, and the non-clogging feature of the single-hole injection nozzles.

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NEWS FROM Washington

By Special Correspondent

INTERNATIONAL problems are being set up for the attention of Congress in a fashion that is quite different than ever before under the New Deal. The President recognizes that these problems must not become partisan issues. Evidence of this is clear in his naming of Governor Alf M. Landon as a member of the delegation to assist Secretary of State Hull at Lima, Peru, this month (December). Other than political considerations also governed the selection of that group, which includes spokesmen of both A. F. of L. and C. I. O.; but the result is really a united front of all parties and interests believed important in determining subsequent legislative action in Washington when the conference findings come up for Senate ratification.

Financial burdens of tremendous magnitude will be assumed in the authorization for new military facilities. But the actual spending next year may not be more than a quarter of a billion dollars above that which was contemplated before Munich. There is no doubt, however, that the President has taken such a stand with respect to preparedness for the Western hemisphere that there will be no backing down, regardless of the political controversies which may be stirred in Congress. It is not expected, however, that the newly enthused Republican members of Congress will use this subject very much in any effort to embarrass the President. In times of strain, that "just isn't done, don't you know."

Trade Agreements

INDUSTRIALISTS appear genuinely pleased with the British and Canadian trade agreements signed on Nov. 17. The numerous cuts in tariff appear to have been selected in a fashion much less embarrassing to many divisions of business than had been feared. There seems to have been a collective sigh of relief when the terms of these near-treaties became known.

But the mining industry is not conspicuous among those pleased. Concessions to Canada included a number of products which seems to cause considerable anguish, but even there the cuts have been less than were frequently forecast some months ago. Most important commodities from the standpoint of the miner are nickel, aluminum, zinc, cadmium, ferro-alloys, and such mineral products as lead, pigments, plated ware, boron carbide, and a variety of nonmetallics, both crude and processed. In a number of instances the fact that goods were bound on the free list is far more significant than the tariff cuts on other commodities.

It seems obvious that the dominating influences which governed the trade negotiations had little, if anything, to do with mining and minerals. Outstanding achievements of the State Department were really increased opportunity to reach British markets with manufactured foods, machinery, and such equipment as automobiles, typewriters, and the like.

Some keen analysts of the international trade situation are warning that a substantial influx of British goods may be expected soon. But these same forecasters point out that the outflow of American goods will follow rather promptly thereafter, being delayed only a bit because generally it takes a little longer to get ready for marketing manufactured products than for importing of the raw materials on which numerous concessions have been made.

The outstanding significance of the whole affair is not industrial at all; it is mainly political in an international sense. By this group of important actions, the English-speaking peoples of the world have declared an intention to cooperate in business matters. This, the rest of the world well understands, means also in matters of international economy and perhaps even cooperation in defense. Thus the two most important world democracies announce themselves as allies. France, usually spoken of as the third important democracy, now classes only as a third-rate power.

Zinc Tariff

QUALMS OF CONSCIENCE evidently disturbed State Department negotiators when reducing the zinc duty in the Canadian trade agreement. The official explanation from the State Department regarding this action fairly well pictures the Administration philosophy in such matters. That statement was:

"The duty on zinc ore (based on zinc content) has been reduced from 1½ to 1⅛c. per pound, or by 20 per cent, with a corresponding reduction from 1¾ to 1⅜c. per pound on zinc metal. The United States is the world's largest producer of zinc, but its consumption is so great that in the last few years, imports, chiefly of ore and unrefined metal, have exceeded exports; the excess, however, has been a very small fraction of domestic consumption. A large part of the imports enter free of duty for treatment in bond and reexport, and another considerable part goes into articles which are exported with benefit of drawback. Prices of zinc fluctuate widely and the duty on the ore has been equivalent to from 33 to 109 per cent ad valorem and that on zinc metal to from 33 to 65 per cent ad valorem in recent years. The domestic price of zinc has usually exceeded the London price by not much less than the duty. The zinc-mining industry is important in a number of American states. The rates fixed in the agreement will leave substantial protection for the domestic producers of this commodity. Zinc is an important material for various American manufacturing industries."

On Nov. 21 the domestic price of zinc dropped from 5.05c., St. Louis basis for Prime Western to 4.75c. St. Louis and on Nov. 26 the price of zinc concentrate in the Tri-State area dropped from $34.00 to $30.50 per ton.

Cadmium Tariff

THE following terse comment illustrating the superficial reasoning and misinformation that apparently guided negotiations in the trade agreement on cadmium appeared in the Nov. 24 issue of *E.&M.J. Metal and Mineral Markets:*

"As if the reduction in the zinc duty were not enough to contend with, the agreement with Canada lowers the tariff on cadmium, largely a byproduct of the zinc industry, by exactly 50 per cent. And the following warped information on cadmium is contained in the official analysis that led to the change in the duty:

"Cadmium.—The duty on cadmium has been lowered from 15 to 7.50c. per pound. This metal is a byproduct of the copper refining industry, and constitutes only a very small fraction of that industry's products. The use of cadmium has increased rapidly in recent years, especially for automobile bearings. United States copper refineries have been unable to supply these growing requirements and imports have risen sharply. The price has advanced greatly, the average unit value of imports in 1937 being over four times higher than in 1933 and 1934."

We would like to be charitable and believe that the use of the words "copper refineries" occurred because of one of those mental lapses that most everybody is familiar with. But the new use for cadmium came with such speed that the industry itself could not properly appraise the situation that obtained during the period of excitement that followed the first news of the discovery that cadmium was to play an important part in the automobile industry. Ford is still using the cadmium bearing and is obtaining the metal at much lower prices than those named during 1937. Owing to the recent depression producers have a surplus of cadmium on their hands and are offering the metal in ordinary commercial forms at 65c. per pound. The London market is down to about 55c. per pound. A year ago the price of commercial sticks was $1.25 per pound in the United States market and it appears that those engaged in drawing up the trade agreement must have used 1937 as an average year for cadmium."

As a result of the lower tariff the price of domestic cadmium was lowered to 60c. per pound on Nov. 22.

Nepheline Syenite

A NOVEL TYPE of tariff plan is applied in the Canadian-American trade agreement with respect to nepheline syenite. The State Department interpretation of this is:

"This commodity is not specifically named in the Tariff Act, but the crude form is at present free of duty under a 'basket' paragraph, and the ground product is dutiable under another basket paragraph. This is a new article of commerce, production of which thus far has been virtually confined to Canada. Nepheline syenite may be substituted for feldspar in certain important uses, and the new agreement consequently provides a safeguard for the domestic feldspar industry. Crude nepheline syenite is bound free of duty but subject to a

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Swinging an 8-yard bucket on a 165-foot boom, A. J. Schrader's Bucyrus-Monighan 6160 strips coal deposits near Taylor, Penn.

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reservation. If the imports (of the crude and ground material combined) in any year exceed 50,000 tons the Governments of the United States and Canada will consult with regard to the measures to be taken. If no agreement is reached, the United States reserves the right to impose a customs duty on imports in excess of the quantity mentioned; in the case of the ground product this charge would be additional to the present duty, fixed at 15 per cent by the agreement. This arrangement will permit considerable expansion of Canada's trade in this new material and will enable United States industry to use it for those purposes for which it is peculiarly suited."

"Stockpile" Controversy

CONGRESS will reconsider soon the legislation proposing that Uncle Sam build a great stockpile of minerals and metals for which interrupted imports might be serious. Commodities like manganese, chromium, tin, antimony, sheet mica, crucible-grade graphite, and a number of others will be under consideration. It is expected that the President will support the bill which was drafted a year ago by a committee representing five of the executive departments: War, Navy, State, Commerce, and Interior. The fact that all these departments advocate the measure indicates that no international complications are expected. But there is plenty of controversy arising over a couple of domestic issues.

Some of the members think that the Mining and Metallurgical Society of America, though advocating the measure as a whole, should oppose two features of the bill. These critics of detail (important but still no more than detail) do not want the President to have any authority to use material from such stockpile in even a major emergency, unless *military* contingencies are involved. The same critics also oppose some of the exploration and development work proposed by the bill to be done by the Interior Department.

Supporters of the measure, who seem to have much the better of the argument around Washington, reply about as follows: (1) To prevent the President from using a mineral stockpile owned by Uncle Sam in the case of bona fide non-military emergency is to imply that the President cannot be trusted. There seems to be no ground in past experience for believing that such a stockpile when it is developed a few years hence would ever be used, as the critics fear, for political purpose, or to discipline a domestic industry. This provision for non-military emergencies is probably not very important, but it is likely to stay in the bill if it passes. (2) Opposition to development work by the Bureau of Mines and the United States Geological Survey roots in either of two sorts of fallacious reasoning, according to the advocates of the legislation. They say that the critics, taking such stand, must assume: Either, that we know plenty already about mineral resources, and how to put them into use in an emergency on short notice. Or, these bureaus can't be trusted in to further our knowledge on these important matters.

Apparently, the critics deny both of these alternatives. Their side of the argument seems to go something like this: The bureaus of the Interior Department are trying to sharpen their appropriation axes to the tune of half a million dollars a year on the preparedness grindstone. The kind of things that these bureaus would do might give us more knowledge; but those things are just as likely to result in competition with present industry. That is unreasonable, and may be in nature quasi-subsidized. The bureaus, though starting with the best of intentions, which every one admits, might find themselves forced for political reasons into such improprieties as would represent competition by government activity with what should be wholly commercial enterprise.

Both sides of the argument can be made to sound logical. Both, however, seem to dodge the real issue, which has little to do with Interior's bureau activities. This real cause of controversy is roused by a desire of certain domestic producers to have their present uneconomic business stimulated or subsidized regardless of the quality of the product which Uncle Sam would have to buy from them.

In half a dozen cases, it seems, this sort of difficulty would not be very different than the battle of last year over the quality of manganese compounds specified when the Navy was trying to build up a small stockpile. It was then charged that specifications were being written to permit use of the material from domestic sources even though stockpiles so created did not serve the real purpose intended of making highest-grade reserves available to help out in case of emergency. Some of the chromium battle was not essentially different.

The advocates of specifications for *only high-grade* materials urged that policy for three important reasons:

1. The shock of changing commercial operations at the time of emergency is eliminated if only high-grade commercial reserves of ore or metal are in the stockpile.

2. Such high-grade reserves may often be used mixed with low-grade domestic material, serving as a "sweetener" and making otherwise unacceptable domestic goods commercially workable in an emergency.

3. The high-grade reserves give a maximum of total protection values for each million dollars invested.

These and many other less important, but still controversial, aspects of the bill are likely to be thrashed out in hearings by Congressional committees if the Administration really puts a push back of this bill. Initially, the bill is likely to be just like the one which in the last Congress was known as the Thomas Bill, S. 4012. (See *E.&M.J.* of last year for frequent references.)

Strategics Survey

MINERALS of a strategic or critical nature are to be resurveyed immediately as a part of the preparedness studies of the War Department. Working as a mineral advisory committee to the Assistant Secretary of War there is now organized a small group of mineral economists representing industrial, educational, and governmental groups, under the chairmanship of Arthur C. Dwight. This committee is charged with the responsibility of bringing up to date the Government's knowledge on these important mineral commodities, so that necessary plans may be made by the War Department through the Assistant Secretary of War, who by Congressional act is charged with the responsibility for all these matters.

This committee will call on a substantial number of outside specialists in order to cover completely all aspects of the important questions. It is expected that the resulting reports, which will presumably be confidential in nature, will treat of substantially the same subjects as did "International Control of Minerals." That document was the result of a joint study, published in 1925 by A.I.M.E. and the Mining and Metallurgical Society of America.

Several of those who served on the old undertaking are active in the new committee. Officials express the hope that the requests for information which go out as a part of this resurvey will have the prompt and comprehensive attention which the national interest seems to require. If there be information that must be retained as confidential for the guidance of policy makers in Washington, arrangements can be made to safeguard these facts, it is expected. The important thing will be to get all of the important facts so that Uncle Sam may know just where and how fast he can get necessary mineral supplies should sources of import be cut off.

News "Fines"

Silver Buying—Certain financial experts have urged that the United States Treasury be protected against "further useless expenditure" of public funds by stopping the buying of silver. That action will be taken with reference to foreign silver only when it ceases to be important as a part of our Latin-American dealings, particularly those with Mexico. There is still less chance of accommodating these economy-minded folks with reference to newly mined domestic silver. Even in a post-election period this metal is too important in the mining states.

Mine "Executives"—There is growing evidence that foremen and others who actually labor in much the same way as those whom they direct will not be exempted from the 44-hour week under any claim that they are employed in "executive or supervisory" capacity. Unless such men have the authority to hire and fire, and do little of the same class of work as their subordinates, they are not likely to rate such exemption, it now appears.

Mexican Quandary — The United States would like to meddle with certain Mexican Government policies affecting minerals, which are quite as serious as those affecting petroleum. The main obstacle is the probable Latin-American reaction. There is fear that the Western hemisphere unity of defense may be more important to Uncle Sam than the very evident losses suffered by industries in Mexico or other near-by countries. This largely accounts for the ineffective procedures of the State Department in discussions with Mexico.

Angles of the Wage-and-Hour Law in the Non-ferrous Metal-mining Industry

EFFECTIVE ON OCT. 24, the Fair Labor Standards Law, according to Administrator Andrews, raised the pay of 750,000 persons and lowered working time of approximately 1,500,000. The mining industry has sought to comply with the law, and a brief review of first reactions on employees and employers in some of the mining states is of interest. Mr. Andrews when questioned from Butte whether gold-mine operators were subject to the law advised:

> "The Administration has no power under the act to exempt the gold-mining industry from the application of the law. Whether the gold-mining industry under the existing economic situation with reference to gold is subject to the Fair Labor Standards Act is ultimately a question of interpretation for the courts, and the administrator has no power to issue any binding ruling."

NEVADA—Effects of the wage-hour law in Nevada are as yet perceptible only in the copper mines of the Ely or Robinson district, White Pine County, where large numbers of men are employed. Mine forces here have been increased to meet the hour requirements of the law, with resulting decrease in workers' income, and the outcome has been intense and growing dissatisfaction on the part of the workmen. In precious metal mines of the State generally, a rescaling of the nominal hourly wage leaves the situation virtually unaltered; men work the same number of hours for the same pay as formerly, since no mine workers have received as little as the 25c. hourly minimum prescribed by the act.

Under this practice, application of the law involves an infinitely greater amount of bookkeeping, with some confusion among workers, and both employers and employees decry the measure as needless, without benefit to the miner and as a potential source of added expense and labor unrest. Also, both employers and workers hold that application of the law involves enforced hiring of incompetent labor in the mines and consequent impairment of labor efficiency. Some added expense is indicated as a result of increased housing requirements and more office work. Among employers, it appears to be the consensus that whereas the law's effect on the industry is not yet apparent, no adequate appraisement of its final effect is possible until the administrative agency makes clear the status, interstate or intrastate, of mining and metal producing projects of various types, as well as its interpretation of hour requirements under the act.

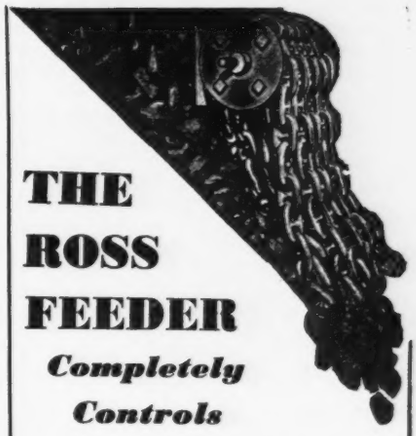
UTAH—Operators of mines, mills, and smelters are collaborating to overcome the handicap of the 44-hour week as provided for by the wages and hours act. The consensus of opinion seems to be that the terms of the act do not readily conform to the needs of the industry. The Utah statutes provide for an eight-hour day from "collar-to-collar." In order to conform with both the Federal and the State law, operators of mines and metallurgical plants are trying out a five-day week, eight hours daily. This, it is agreed, is not the best arrangement because it allows the men employment for only five instead of six days. But operators feel that they cannot ask miners to come back on the sixth day for only a four-hour shift. Some students of the problem have suggested that perhaps the solution would be for metal-mine operators and employees to enter an agreement that a working day, like that defined by the contract governing coal-mine operations, should consist of seven hours "at the face." Another suggestion contends that the best policy would be to work eleven consecutive days, with three days of rest every two weeks. Before any policy satisfactory to both employers and employees can be definitely adopted, there must be more time for trial.

IDAHO—Adjustments in the Coeur d'Alene mining district were necessary to comply with the new Federal wage-hour law, but these were made with very little disturbance in the usual routine. With one exception, the larger operators took the full step of the ultimate hour limit and placed their plants on a straight 40-hour week of five eight-hour days. This was done by the Bunker Hill & Sullivan, the Federal Mining & Smelting Company, Hecla Mining Company, and others. At the Sunshine mine, three shifts have been used for several years, and the six-day rule was maintained with seven hours and twenty minutes to the working shift for a 44-hour week. Starting and quitting time remain the same as before, but lunch periods were increased from 30 to 40 minutes. Daily wages remain the same, but hourly rates are set on the basis of seven hours and twenty minutes per day.

At properties where wages are on a daily base, the cut from six to five days means the loss of one day's wage from each week's pay envelope for the miners. Few additional men are required, but an increase in underground mechanization will no doubt be more seriously considered to hold down production costs. At the mills and smelters, additional men were required, as these plants operate on a three-shift basis.

Complaints have been heard from mines in remote areas where the miners are provided quarters in company bunkhouses and means of recreation are slight. These miners would rather work seven days of eight hours each rather than sit idly around camp and lose two days' pay each week while their board bills continue without interruption. These groups are asking for amendments that would allow them to accumulate extra time by continuous work and then take their lay-off during the summer of a full month or whatever time they might have to their credit above the hours fixed by the law.

TRI-STATE—Wages in the Tri-State district have been well above the 25c



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minimum, so no adjustments were necessary to comply with the Fair Labor Standards Act. Most of the mines, mills, and tailings re-treatment plants have put men on a schedule of five eight-hour days. As practically all the mines had just increased their operating schedules from three or four days per week to five days, no adjustments were necessary for these operations. In the case of tailings re-treatment mills which operate seven 24-hour days, swing crews are used. This necessitates the employment of seven men where five men were employed before. Since most re-treatment mills have a total crew of about 30 men, this did not cause any large increase in employment. A few such mills changed from three eight-hour shifts per day to four six-hour shifts. This increased the number of employes 33 1/3 per cent, but the number involved was again small. At least one re-treatment mill has continued on the basis of three eight-hour shifts, seven days per week, paying overtime for the extra twelve hours. It is reported they are paying wages lower than the majority of the operators, but above the minimum required by the Wage-Hour Law. One small mine is working its men seven hours and twenty minutes per day, six days per week, or 44 hours per week. The daily wage was not changed. This schedule was apparently working satisfactorily.

At present no increase in operating costs is indicated for mines and mine mills, as only minor adjustments were necessary as for watchmen, pumpmen, and hoist operators. What will develop when or if demand should require the mines to go on a six-day week is still for the future to decide. In the case of re-treatment mills, loss of efficiency due to swing crews may increase operating costs, but it is still too early to obtain any data to substantiate this. As no decided increase in operating costs is indicated for the immediate future, and because of its limited application, underground mechanization will probably not be pushed to offset the new law.

UTAH

Production Starts at Ophir Flotation Plant

About 400,000 tons of tailings will be treated—C.I.O. finally signs agreements with operators—Ventilating system installed at American Flag mine

▶ The new 600-ton flotation plant of the International Smelting & Refining Company went into operation Nov. 21 at Ophir for the treatment of 400,000 tons of tailings from the dumps of the old Ophir Hill Consolidated mill. Operations are supervised by B. L. Sackett, general superintendent of the International smelter at Tooele. Wells, Inc., of Reno, Nev., has the contract for hauling the tailings from the old dumps to the mill and the concentrate to the Tooele smelter. The mill, it is expected, will produce daily 60 tons of concentrate assaying 20 oz. of silver to the ton, 20 per cent lead, and 5½ per cent copper. About two years will be required to complete treatment of the tailings. Most of the equipment was moved from the old Utah Apex Mining Company's mill at Bingham.

▶ Hans Lundberg, of Toronto, Canada, is directing a geophysical survey of the Chief Consolidated Mining Company's properties at Eureka. Surveys have been started in Apex Standard territory and on the area between the Chief Con No. 2 shaft and North Lily of the International Smelting & Refining Company. A promising lead has been outlined in Plutus ground. The Chief Consolidated Company has 30 sets of leasers working in its ground.

▶ Conditions governing metal mining were considerably stabilized when, on Nov. 9, L. G. Robinson, president of Park City Local No. 99, and H. A. Davis, president of District No. 2 of the International Mine, Mill and Smelter Workers, and James Ivers, general manager of the Silver King Coalition Mines Company, O. N. Friendly, general manager of the Park Utah Consolidated Mines Company, and Gloyd M. Wiles, general manager of the Park City Consolidated Mines Company, signed the long-debated contract governing wages and hours effective until June 30, 1940. Terms are the same as those agreed to last summer but held in abeyance because the executive board of the union at first refused to ratify the contract. Tintic operators signed the labor agreement with the union on Nov. 19 and the American Smelting & Refining Company on Nov. 21. Signing of the agreement by the Tooele local and the International Smelting Company during October was followed by the reopening of the Tooele smelter on Nov. 1. About 200 men went back to work at Tooele.

▶ Silver King Coalition Mines Company reported for the quarter ended Sept. 30 a net loss of $78,087.70. after all taxes and depreciation. For the first nine months of the year, the company reported a net profit of $126,361.29 after all taxes and depreciation. Park Utah Consolidated Mines Company reported for the same period a net loss of $147,500 after taxes and depreciation, but before depletion. Both properties, situated at Park City, are still shut down.

▶ A ventilating system is being installed at the American Flag mine by D. C. Despain and associates, who are operating the Park City property on a lease basis. Eighteen men are taking out 100 tons of ore weekly, reports Mr. Despain, all from the abandoned workings in the upper levels. When the ventilating system is installed, operations will be extended to the lower levels of the mine.

▶ The Mineral Valley Gold Mining Company has been incorporated to develop a placer property at the head of Amasa Valley, in the House range, 48 miles southwest of Delta and 8 miles south of the highway leading to Ely, Nev. Operations were begun by sampling the ground with a small gravity concentrator driven by a gasoline engine. Don M. Moody, of Deseret, who is directing operations, reports that twelve holes sunk at different points in the basin to a depth ranging from several feet down to 30 ft. without reaching bedrock have shown values of 70c. a yard in gold. If test operations prove satisfactory, Mr. Moody says that the company will install equipment in the spring large enough to dredge and wash from 500 to 1,000 yd. of gravel daily. A road is to be built to the prospecting area by Millard County and the company.

MONTANA

Small Mines Resume Work As Smelters Reopen

Siliceous ore requirements at lead and copper smelters being met by several properties—Cyanide plant being reconditoned by Golden Messenger Corporation

▶ With an increasing need for siliceous fluxing ores at the Washoe Reduction Works of the Anaconda Copper Mining Company to balance the increasing copper production from Butte, and with the reopening of the East Helena lead smelter of the American Smelting & Refining Company, interest is again being directed toward reopening many small gold, silver, and lead properties requiring these plants for the disposal of their products. One of the larger units, the Comet mine of the Basin Montana Tunnel Company, producer of lead-zinc and auriferous iron concentrates, started hiring on Nov. 15. Normally, this plant employs about 80 men. Many small operators, who had continued to extract ore which was stockpiled until shipment was receivable, have once again returned to normal production. Many siliceous gold ore shippers are operating in Madison, Beaverhead, Granite, Powell, Jefferson, Lewis and Clark, and Broadwater counties.

▶ The Golden Messenger Corporation has acquired a sub-lease from L. W. Hoffman on the Golden Leaf group of the New York Mining Company at Bannock. A 100-ton cyanide plant is being reconditioned at the property and production from oxidized gold ores will soon begin. The ores occur in limestone near a granite contact, and in former operations no extensive test of sub-water level base ores was made. It is now planned to conduct such a test under the direction of J. C. Archibald. Hoffman will remain in charge of Bannock operations of the Golden Messenger Company, which also operates a 150-ton mill on its property, near York.

▶ A new corporation has been formed to reopen the old Green Campbell mine, near Silver Star. The directors are all Montana men and include W. C. Giebel, of Silver Star. The property is situated about half a mile south of the Broadway mine, now being operated by the Taylor Nelson Knapp Corporation. It was very productive of high-grade gold nearly forty years ago.

▶ Of interest to all Montana mining people is the letting of the contracts on Nov. 15 for the construction of a new $200,000 library at the Butte School of Mines, at Butte. Museum facilities will also be incorporated in the new building, which is financed by a $90,000 grant and a Federal public works loan of $110,000, to be retired over 25 years through the proceeds of a bond issue sold to the Wells-Dickey Company, of Minneapolis.

TRI-STATE

Cut in Zinc Tariff a Serious Blow to Miners

Price of domestic metal and zinc concentrates quickly drops as a result of lower duty on zinc in Canadian trade agreement

▶ Announcement that the tariff on zinc was lowered in the Canadian trade Agreement was like a bombshell to miners, operators, and ore buyers in the Tri-State region. The duty on zinc ore (based on zinc content) was lowered from 1½c. to 1.20c. per pound or by 20 per cent, with a corresponding reduction from 1.75c. to 1.40c. per pound on zinc metal. The effect of this new tariff has lowered the price of domestic zinc on two occasions already and zinc concentrate has been lowered $3.50 per ton from $34.00 to $30.50 per ton.

The probable effect of the tariff on the largest zinc-producing district in this country has been pointed out by Evan Just, Secretary of the Tri-State Zinc and Lead Ore Producers' Association, who on Nov. 27 said in part:

"The people of the Tri-State zinc and lead mining district of Oklahoma, Kansas, and Missouri have been stunned by the action of the State Department in including zinc and zinc ores among the tariff concessions extended by the United States in the recent trade treaty with Canada. Zinc mining is the backbone of our industrial life—an investigation of mining costs makes it easy to understand how an arbitrary cut of $3 per concentrate ton will affect our industry. Over the past ten years average profits have been 88.4c. per ton, approximately one-fourth the drop in price caused by the trade treaty.

"Obviously, some of our producers will have to shut down unless they reduce wages. These facts were known to the State Department, and their action notwithstanding is incredible to us. The worst sufferers will naturally be our workmen. During the recent recession the industry was able to keep a large portion of its men employed, but only by dint of two- or three-day work weeks. This arrangement, although it prevented starvation or going on relief, reduced the scale of living to the barest essentials of existence.

"Translated in terms of employment, the loss of one-third of our zinc concentrate market means that 4,000 men in the Tri-State mining district and smelters handling its concentrates will lose their jobs."

▶ Remilling rights for tailings-pile tonnages on the Robert Lotson and Little Greenback allotments were offered for sale at public auction on Nov. 10, at the Quapaw Indian Agency offices in Miami, Okla. Carl Britt was high bidder on the Lotson allotment, with a bonus bid of $26,000. Estimated tailings available totaled 3,707,205 tons. Eagle-Picher Mining & Smelting Company was awarded the Little Greenback allotment on a bonus bid of $41,000. Estimated tailings available were 849,621 tons.

Sauerman Slackline Cableway at Goldroad mill hauls tailing 1,000 ft. from old pile to bin on hill above floor of mill.

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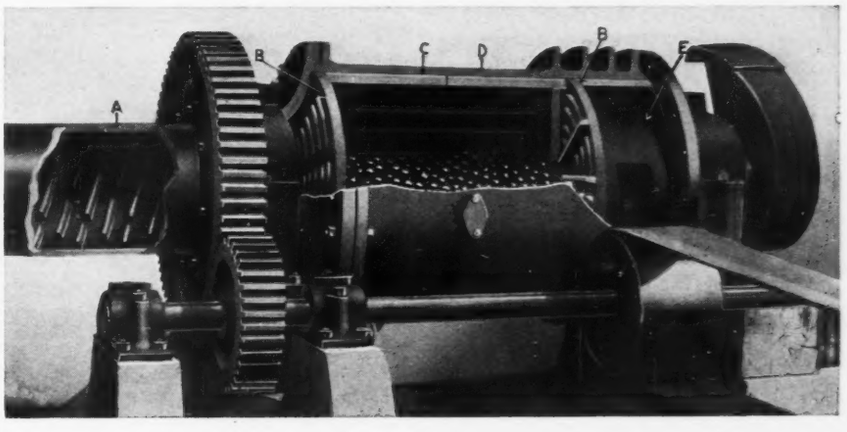

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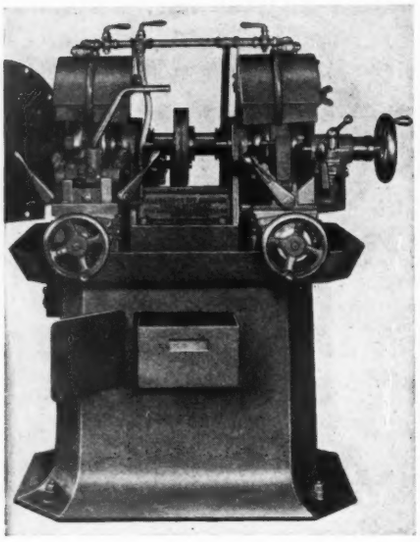

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IRON COUNTRY

Ore Shipments for Season About 19,000,000 Tons

Figures show sharp decline from those of last year, when around 63,000,000 tons were shipped—Ventilation shaft completed at Ely

▶ Lake Superior iron ore consumed in blast furnaces during October amounted to 2,780,585 tons—an increase of 466,720 tons over the September figures. The total shipments of Lake Superior iron ore for the 1938 season will run between 18,500,000 to 19,000,000 tons. If the consumption of iron ore increases each month so that the average will run about 3,000,000 tons per month until May 1, 1939, the balance on hand will run around 21,000,000 tons—or a normal balance to begin the 1939 shipping season. Producers believe business will increase during the first quarter of 1939, and that this balance may therefore be lower than the figure given.

▶ The 5½-ft. hole that was drilled for a ventilation shaft at Ely, Minn., for the Zenith mine of Pickands-Mather & Company has now been completed at a depth of 1,208 ft., and J. B. Newsom, who has been in charge of this work, has transferred his crew to California. A description of this job appeared in the October *Engineering and Mining Journal*.

▶ Oliver Iron Mining Company is now operating all its properties on a four-day-per-week basis—an increase of one day.

▶ Stripping operations are now under way at practically all of the mines on the Mesabi range, and many of these jobs will continue until late in the winter.

MICHIGAN

Receivership of Seneca Copper Corporation Ends

Bondholders of company plan to convey a five-year option to Calumet & Hecla Consolidated Copper Company

▶ The receivership of the Seneca Copper Corporation and the Seneca Copper Mining Company, in effect since 1931, has been terminated by a Federal court order, signed by Federal Judge Fred M. Raymond at Grand Rapids. William F. Hartman and Frederic R. Kennedy have been discharged as receivers, and the Aetna Casualty & Surety Company has been released from further liability under their bond. The Seneca property was placed on sale May 4 last, and the Peninsula Copper Company, of Grand Rapids, organized by Seneca bondholders, was high bidder at $190,000. The bondholders' group announced that it planned to convey a five-year option to the Calumet & Hecla Consolidated Copper Company. Under the option agreement, which carries an exclusive right to explore the property, located in Keweenaw County, Calumet & Hecla will advance funds to pay outstanding taxes, labor and compensation claims, and various court costs, not exceeding $200,000, and will keep the property free from all labor, material, or other liens. The Calumet company will have the right to purchase the property at any time within the five-year period for $750,000 cash, or it may surrender the option in any year upon 60 days' notice. If it surrenders the option at any time and before reimbursing itself from operations at the Seneca mine, all funds spent for payment of taxes or other claims and development work will be absorbed by the Calumet company. If it decides to pay the purchase price, Calumet & Hecla will not make any deductions from the $750,000 on account of taxes, exploration, and other expenditures by it.

CANADA

New Production Records for Falconbridge Nickel

United States Smelting, Refining & Mining Company and American Smelting & Refining Company active in Quebec and Ontario—New mines in Caribou district, British Columbia, enter production

▶ Copper produced in Canada was up 16.7 per cent for the first nine months of 1938, amounting to 441,216,461 lb., compared with the 1937 figure in the same period of 378,097,890 lb. The output of nickel for the Sudbury area in the first nine months diminished 4 per cent, 159,863,075 lb. against 166,972,210 lb. a year ago in the same period.

▶ The Quebec Bureau of Mines reports gold production from 24 mines in the Province valued at $22,537,365 for the first nine months, an increase of 24 per cent over the record for that period in 1937.

Quebec

▶ Perron Gold Mines, starting production four years ago, has just declared its first regular quarterly dividend of 4c. a share, plus a 1-c. bonus. The new No. 5 shaft is being sunk to 1,150 ft. The 350-ton mill is slated for increased capacity next year. J. P. Norrie is managing director.

▶ Through an increase of 500,000 shares in authorized capital, Waite Amulet Mines proposes to finance development of the spectacular new orebody and mill expansion to a capacity of 1,000 tons, according to an announcement late in November by the president, James G. Murdock. A shareholder's meeting is being called to authorize issuing 300,000 of the new shares at $6 per share. Any of this stock left unsubscribed by shareholders will be bought by Noranda Mines.

▶ Denis R. Agar, manager of Sladen Malartic Mines, announces a new record production for October from the new

Concession Made by United States in Trade Agreement With Canada and United Kingdom

▶ The following is a list of commodities upon which concessions were made by the United States in the recent trade agreements with Canada and the United Kingdom as they affect metals and minerals. In addition to those items given below nepheline syenite was found on the Canadian free list on which it heretofore did not appear.

Trade Agreement With Canada

Paragraph Tariff Act of 1930	Commodity	Rate of Duty: Before New Agreement	Rate of Duty: Under New Agreement	Ad Val. Equivalent of New Rate
207	bentonite: unwrought & unmanufactured..	$1.50 per ton	75¢ per ton	....
	wrought & manufactured.....	3.25 per ton	$1.62½ per ton	5%
207	crude feldspar.....	35¢ per ton	25¢ per ton	4%
208 (f)	untrimmed phlogopite mica, small pieces.....	15%	10%	10%
208 (g)	phlogopite mica waste and scrap valued at not more than 5¢ per lb.....	25%	15%	15%
208 (h)	mica, ground or pulverized.....	20%	15%	15%
209	talc, steatite, or soapstone ground, etc.....	25%	17½%	17½%
214	ground feldspar.....	30%	15%	15%
214	ground nepheline syenite.....	30%	15%	15%
302 (l)	boron carbide.....	25%	12½%	12½%
374	aluminum, aluminum scrap, and alloys, crude.....	4¢ per lb.	3¢ per lb.	20%
378	cadmium.....	15¢ per lb.	7½c per lb.	6%
393	zinc-bearing ores, except pyrites containing not more than 3 per cent zinc, on zinc content.....	1½¢ per lb.	1⅛¢ per lb.	45%
394	zinc in blocks, pigs, or slabs, and zinc dust.....	1¾¢ per lb.	1⅜¢ per lb.	27%

Trade Agreement With the United Kingdom

Concessions On Imports Into the United States.

				Reduction of Duty	
49	magnesium oxide or calcined magnesia.....	7¢ per lb.	5¢ per lb.	29%	30%
72	litharge.....	2½¢ per lb.	2¼¢ per lb.	10%	28%
72	red lead.....	2¾¢ per lb.	2¼¢ per lb.	18%	22%
72	lead pigments, n.s.p.f.....	30%	20%	33%	20%
81	sodium chloride or salt, in bulk..	7¢ per 100 lb.	4¢ per 100 lb.	43%	24%
207	kaolin or china clay.....	$2.50 per long ton	$1.75 per long ton	30%	18.9%
207	Fuller's Earth: unwrought & unmanufactured.	$1.50 long ton	$1.00 long ton	33%	7%
	wrought or manufactured.....	$3.25 long ton	$2.00 long ton	38%	14%
207	fluorspar.....	$5.60 long ton	$4.20 long ton	25%	24%
213	graphite or plumbago: crystalline — lump and chip.....	30%	15%	50%	15%
	dust.....	30%	15%	50%	15%
301	amorphus.....	10%	5%	50%	5%
302 (k)	chrome metal or chromium metal.	25%	25%	Bound	25%
397	lead manufactures, n.s.,p.f.....	45%	3¢ per lb. but not less than 22½% nor more than 45%	n. a.	n. a.

Commodities Bound on the Free List (U.S.)

1647	chrome ore or chromite
1777	sulphur in any form
1801	witherite, crude, unground

mill of 328 tons daily. The firm of Futterer & Reid has been appointed general manager.

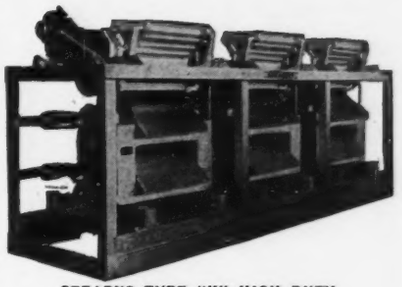
▶ Early in November the 750-ton mill of East Malartic Mines started tuning up and within two weeks was treating 600 tons a day. The equipment is believed capable of handling up to 900 tons, to which additions will be made next year to step up production to 1,200 tons.

▶ Dumico Gold Corporation, adjoining the Beattie Mine on the east, has met with good luck in extending development work to a depth of 750 ft. This improvement in grade has not been suggested by preliminary drilling but is being verified as work advances on the 600 and 750 levels, as reported by B. G. Anderson, mine superintendent.

▶ Bousquet Township, west of the Cadillac-Malartic area, will soon have its first producing mine. Underground exploration on the Cassels Duval checks with the million-ton block of better than $7 ore indicated by diamond drilling. Shaft sinking is financed by United States Smelting, Refining & Mining Company, which has taken options, through exploration subsidiaries, of both Cassels Duval Mines and the adjoining Norgold Mines. W. H. Graves, Jr., is superintendent for United States Smelters and A. W. Derby, consulting geologist. On the Cassels ground 41 drill holes were put down; the eighth hole is now in progress at the Norgold.

Ontario

▶ American Smelting & Refining Company, controlling Premier Gold, in British Columbia, and its subsidiary in Kirkland Lake, Toburn Gold Mines, holds options on three interesting geological bets in northeastern Ontario. Of these, Continental Kirkland Mines represents a large acreage adjoining east of Toburn. In spite of inconclusive results after a year of underground exploration on the 800-ft. level, it is planned to drift from a winze down to 925 ft. and continue the ore search. The second operation is at the former Argonaut mine, several miles east, now organized as Beaverhouse Lake Gold Mines. Underground sampling has not yet measured up to indications on surface and in drill cores, but further in-



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HIGH STEARNS DUTY

Steady progress in the Cariboo district, British Columbia, recently brought in the 100-ton mill at the Cariboo-Hudson gold mine, on the Barkerville gold belt 20 miles southeast of the town of Wells. This is one of nine gold properties brought into production in British Columbia during the year

▶CANADA

formation will be provided by diamond-drill holes put down from the 350 level. The third property under option is controlled by Minesta Mines and located on a belt of Temiskaming sediments several miles west of Timmins. Very deep overburden makes diamond drilling a slow process in exploring the possible west extension of Porcupine orebodies.

▶ Falconbridge Nickel Mines report a slight improvement in net income for the third quarter, but lower profits for the first nine months compared with that period last year. Tonnage of ore treated, and production of refined copper and nickel, have increased to larger figures than at any time in the company's history. Capacity production is continuing in spite of failure of sales to prevent increased inventories, as announced by the secretary, N. F. Parkinson.

▶ Mining Corporation of Canada and Ashley Gold Mines jointly control the Jerome Gold discovery, near Gogama, on Opeepeesway Lake. As soon as a winter road is built the 16 miles to the railroad, it is intended to take in a mining plant. Diamond drilling, in the meantime, indicates large proportions for the orebody. Surface sampling on the main showing averages $8.29 cut grade across 18 ft. A second occurrence 1,000 ft. to the east assays up to $15 across maximum widths of 13 ft.

▶ Chesterville Larder Lake Gold Mining Company will have more than half a million dollars in its treasury in January, when construction will be started on a mill with an initial daily capacity of 500 tons. Much of Chesterville's ore is similar of that of the Kerr-Addison, but the final method of treatment will be decided after results have been submitted by the ore testing laboratories of the Department of Mines, based on metallurgical tests now in process.

▶ In its first four years of operation, Young-Davidson Mines has repaid the $800,000 advanced by Hollinger and is now in a position to start distributing dividends. Production figures for the period ended Sept. 30 show that all previous records have been broken, and the earnings are at the annual rate of $400,000. Daily tonnage treated in the third quarter averaged 1,007 while gold recovery improved 17c. to $3.67 per ton, compared with $3.45 in the third quarter of 1937. Weldon C. Young, managing director, states that reserves above the 450 level are sufficient to keep the present mill going for more than four years. Although figures are not available from the new levels at 650 and 850 ft., a drill hole on the 650 showed values of approximately mine average across a 250-ft. width.

▶ The new mill of Cline Lake Gold Mines, in the Goudreau district and controlled by O'Brien Gold Mines, has demonstrated a capacity for handling more than 300 tons a day. Ore values average $11 a ton, with recovery around 97 per cent. Other promising indications of ore have been found on a second and larger mass of granodiorite 1,000 ft. to the west. Dr. George Furnival is geologist and J. O'Shaughnessy mine manager, in charge of a crew of 150 men.

Manitoba

▶ Ore tonnage has been recently increased at Sunbeam Kirkland Gold Mines by development work on the new fourth level at 425 ft., where values have averaged $10.15 over drift width. Dr. J. F. Wright, consulting geologist, estimates 84,050 tons averaging $9.42 to a depth of 350 ft.

▶ Hudson Bay Mining & Smelting Company, with short-term contracts for its copper and zinc sales, is in a position to benefit from the improved metal market. Estimated earnings for the first nine months of the year exceed $3,000,000. The progress report covering third-quarter operations shows shaft sinking completed to the 2,750-ft. level, where both the size and grade of ore were found to be satisfactory.

British Columbia

▶ The most gratifying feature of the mining industry of British Columbia is its diversification, stated Dr. J. F. Walker, Deputy Minister of Mines, at the recent Annual Western Meeting of the Canadian Institute of Mining and Metallurgy in Vancouver. He estimated that the value of production this year will amount to $64,250,000, compared with $74,475,902 in 1937. The decline of about $10,000,000 is due to lower prices of lead and zinc.

▶ At the Privateer mine, new high-grade producer at Zeballos, on the west coast of Vancouver Island, gold to the value of $96,426 was recovered from 2,744 tons milled in the initial period from Sept. 24 to the end of October. D. S. Tait, of Victoria, secretary, states that no attempt is being made to establish a "grade record," but all rock is being treated that will pay operating costs. Thus, although the average width of the vein is 12 in., all material from development headings across drift width of 6 ft. is being milled, and stringered areas are also being mined in bulk.

▶ A recent shipment of 25 tons of sorted ore from the Central Zeballos mine averaged 4.27 oz. gold per ton. Ore carrying less than 3 oz. is being stored underground for milling later. O. T. Bibb is manager. Winter camps are being built at a number of properties in the Zeballos region where it is intended to continue underground work during the next few months.

▶ Gold output from Bralorne, leading producer in the Province, reached a new peak in October, when 8,950 oz., valued at $313,250, was produced from 15,441 tons.

▶ The new 150-ton mill of Gold Belt Mining Company was set in operation on Oct. 24, and in the first regular period of production, from Nov. 1 to 15, bullion to the value of $34,888 was recovered from 2,188 tons milled. About 100,000 tons of ore has already been developed. H. E. Doelle is manager.

▶ The successful development of the Gold Belt, Kootenay Belle, and other mines in the Sheep Creek region, near the town of Salmo, has about offset the disappointing results obtained in recent months at the Wesko, Durango, and Bayonne. At the two former properties, operations have been discontinued, and ore reserves have been practically exhausted at the Bayonne. The development program at Kootenay Belle, on

the other hand, is yielding excellent results. A shaft is being sunk 350 ft. from the sixth level, and Nos. 7, 8 and 9 will be opened from it. A tunnel is also being driven 900 ft. to open the Dixie vein at a depth of 600 ft. Vere McDowall is superintendent.

▶ Two new mines were brought into production in the Cariboo district recently. A 100-ton mill was set in operation at the Cariboo-Hudson on Nov. 14, and the first 25-ton unit of a 50-ton plant was started at the Quesnelle Quartz mine on Nov. 18. The Hudson is situated on the Barkerville gold belt 20 miles southeast of the town of Wells. Production was started at the rate of about 50 tons and is gradually being increased. The deep-level crosscut is expected to reach the main ore zone in December. James MacDonald is superintendent. The Quesnelle Quartz mine is situated 50 miles northwest of Wells, and is reached by road north of Quesnel. T. Norton Youngs is superintendent.

▶ Operations are continuing satisfactorily at the two established lode mines at Wells, the Cariboo Gold Quartz and Island Mountain. Output from the former had a value of $110,915 in October, and that from Island Mountain was $55,894. Placer mining throughout the Cariboo last summer suffered from an unusually dry season.

▶ The underground mill at Big Missouri Stewart in September treated 18,931 tons of ore averaging 0.1176 oz. gold, the total value of output being $70,000 and operating profit, $30,000. The value of mill feed was materially higher than in recent months. In the first six months of production, ended Sept. 30, 97,152 tons was milled, averaging 0.083 oz. gold, and the value of production amounted to about $248,000. Operating profit in this period was around $50,000.

▶ Reward Mining Company reports that its new 75-ton mill at Porcher Island will probably be ready for operation in December. C. P. Riel, president, estimates that ore sufficient for several years' production is indicated. T. M. Waterland is general superintendent.

MEXICO

More Small Miners May Escape 12 Per Cent Tax

Operators having long haul to railway claim profits are cut if tax is paid—Guanajuato Reduction & Mines Company closes property unable to pay new taxes

▶ Guanajuato Reduction & Mines Company was forced to suspend operations in the middle of November because of its inability to maintain profitable operations in face of the recently imposed 12 per cent export tax. About 1,200 employees have been thrown out of work, losing a $4,000 weekly payroll. Federal and State governments are seeking means to have production resumed. Augustus McDonald is manager of the company.

▶ A strike was called at the Monterrey refinery of the American Smelting & Refining Company on Nov. 18. This refinery accounts for about half of the silver production in Mexico. On Oct. 27 a strike was also called, but at the time the government labor board induced workers to return to their jobs on Oct. 29 pending a settlement of differences.

▶ Though mining shared with other industries in Mexico the burden of uncertainty regarding the near future, and labor trouble continued, some developments were under way and others were being planned, with the end of fall. Mining was hampered to some extent by the strike of electric workers in San Luis Potosi, Guanajuato, Queretaro, Michoacan, and Jalisco; but those enterprises that have their own power plants were immune from this annoyance.

▶ Fears of a near-by general expropriation for the industry seem to have passed, as have those of a general strike. Mining supplies more than half of the federal government's revenue, money that the administration needs particularly pressingly right now, what with the elimination of tax income from the oil industry. There have been settlements of minor labor disputes in several sectors, mostly on the basis of the operators giving employees pretty much what they demanded.

▶ Private capital for exploitation of important asbestos deposits that were recently discovered in the Cintalapa district, Chiapas, is solicited by the Ministry of National Economy.

▶ Small-scale miners have become more

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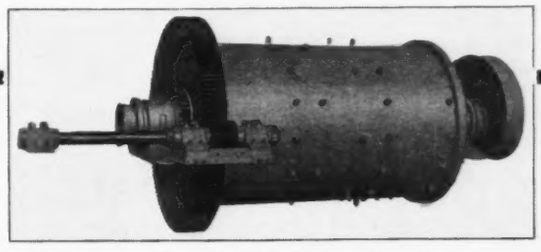

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A recent photo of the Almaden quicksilver mine, in Province Ciudad Real, Spain, where production continues in the hands of the Loyalists. Brick and tile buildings, some erected in the sixteenth century, house equipment for recovery of mercury from this famous mine

▶MEXICO

active with regard to seeking means to protect their interests, in view of the silver situation.

▶ Prospectors and other small-scale Mexican miners are arranging their first national convention for about Jan. 15 at a place to be selected later, to discuss problems they charge the great foreign companies have forced upon them. Zacatecas City seems to be the most logical scene of the convention, which will be attended by from three to fifteen representatives of each mining zone. Efforts are to be made to amend the mining law to compel ore purchasers to pay a fair price. Sponsors of the meeting charge that some buyers pay as low as 40 per cent of the market value of the ore. Changing the mining law to exempt little operators from the responsibilities similar to those of large operators is also to be demanded. Various problems concerning silver mining and marketing and the proposition, that is gaining more support, of free silver minting by Mexico as a protective measure should the United States discontinue buying Mexican white metal at an artificially high price, are other matters that will be brought up.

▶ Cananea Consolidated Copper, Cananea, Sonora, has been obliged by labor agitation to annul its orders for more workers with the national miners' union. The management has requested state protection against sabotage and threats by workers directed against executives. Apparently some workers are still disgruntled, even though the company recently settled a strike, granting the workers virtually everything they requested.

▶ Mines in the La Dura district, near Ciudad Obregon, Sonora, that were abandoned seven years ago because of labor trouble, are to be worked with the aid of American capital, it is reported.

▶ Improvements being made by Cia. Minera C. A. Friz, S.A., a new company of which Dr. C. A. Friz, of New York City, is president, at its properties in the Ensenada district, Lower California, include erecting a headframe, installation of compressed-air equipment, and building a 350-ft. wharf. This company holds concessions to an important onyx tract. The mineral is to be sent by steamer to San Pedro, Calif., for dispatch to Chicago and New York. Offices of the company are at Ensenada and are in charge of Alfonso von Schnabl, Jr., vice-president and secretary.

▶ Exemption from the 12 per cent tax on exports of all ore produced by small-scale miners in zones that are 90 km. from railroads or highways is considered probable. Such miners of the Inde zone, Durango, asked for this exemption, claiming that the tax wipes out good profits resulting from the current exchange rate of 5 pesos per dollar. The Ministry of Finance, since exemption of mining cooperative societies from the 12 per cent tax on their silver exports, has refunded 150,000 pesos (some $30,000) to such societies running properties at Dos Carlos and San Rafael, Hidalgo; Dos Estrellas, State of Mexico, and Rincon Minero y Beneficiadora and San Pantaleon, Zacatecas.

▶ Mexican Government purchase of all silver produced in Mexico as a means of protecting miners from price variations of metal, resulting from foreign transactions, is asked of President Lazaro Cardenas by two Zacatecas miners' organizations, the small-scale miners' union and the mining and treating association. They say that this buying should be paid for with Mexican silver coin or from authorized silver minting by state administrations.

▶ Loans totaling 45,000 pesos ($9,000) have been granted by the Hidalgo government to mining cooperative societies of Dos Carlos, the Apulco smelter, and foundary workers of Zimapan.

▶ Gold, silver, and some of the industrials exports are continuing at a fair rate, despite the 12 per cent tax on foreign shipments.

AFRICA

Rhokana Corporation Boosts Cobalt Production

Plant is erected for differential flotation of copper and cobalt—Mufulira Copper Mines reports lower production costs—Carbon Leader in West Rand drilled over six-mile length

▶ The outstanding feature of the Northern Rhodesia copper activities during the year ended June 30 last was the rather remarkable progress of Mufulira Copper Mines, Ltd. That company's production was 52,436 long tons of blister copper, against 37,230 tons the previous year, and net production costs averaged £26 1s. 2d., a reduction of £1 12s. per long ton. Insufficient power, due to faulty power-plant equipment, prevented a more substantial reduction of production costs, as since the defects were corrected a record low cost of £23 8s. 7d. has been reached. Plant expansion continued. About £412,000 further will be spent this year, bringing the company's production capacity up to 8,000 long tons of copper per month, or approximately 108,000 short tons annually. But this is by no means, A. Chester Beatty, chairman, says, the ultimate capacity warranted by the extent and richness of the orebodies.

▶ Rhokana Corporation's production for the year to June 30 was 76,275 long tons of copper, of which 44,247 tons was sold as blister and 32,028 tons was refined at the company's plant and sold as electrolytic. In addition, 1,662,771 lb. of cobalt (in element and alloy) was produced and sold, against 1,459,237 lb. the previous year. The importance of this byproduct is indicated by Rhokana having added a third electric furnace to its cobalt plant, increasing capacity for the treatment of convertor slags by 50 per cent, and also having erected a plant for the differential flotation of copper and cobalt with a view to obtaining a rich cobalt concentrate. No new mineral deposits considered to be of importance were discovered in the considerable portion of the concession prospected, but diamond drilling of the Konkola area continued. Dr. Bancroft, the consulting geologist, says that thirteen holes along a length of strike of 20,000 ft. suggest that to a depth of about 1,000 ft. the Konkola orebody has an average true width of 18 ft. averaging 2.6 per cent copper, and that four holes between 1,000 and 1,900 ft. have penetrated an average true width of 14.5 ft. averaging 2.7 per cent copper. Chairman Geddes said at the annual meeting: "We are proving to our satisfaction that there is a large deposit of copper at Konkola." He said of the progress at Nchanga Consolidated: "We are more than satisfied at the excellent progress and standard of the work done."

▶ Ashanti Goldfields made a net profit of £109,094 in October, a new high record for all time. Ore milled in October averaged about 1 oz. 5 dwt. per ton, the yield being about 22.6 dwt., against a previous average of just under 20 dwt. In view of recent development underground, the company's consulting engineer is reported to have advised raising the average grade of ore milled.

▶ It is now officially confirmed that West Witwatersrand Areas will form another subsidiary company soon. The area to be leased from the Government is about 4,769 claims, embracing the remaining portion of Farm Blyvooruitzicht and the whole of Driefontein 118. It adjoins the Blyvooruitzich company's property to the east. Chairman W. A. Mackenzie of West Witwatersrand says the Carbon Leader has proved consistently payable and exceptionally uniform in five boreholes over a distance of six miles, and three of these are in the area to be taken up by the new company. There are also indications of payable Main Reef in the western and eastern portions of the area.

PHILIPPINES

New Mills Add to Higher Gold Production

Gold output for first nine months of 1938 substantially above last year—Iron mining holds interest—Supreme Court rules on first test case involving rights of claim locations

▶ The Supreme Court of the Philippines has handed down a decision which, theoretically at least, settles once and for all the question as to whether or not the location of a mining claim prior to the establishment of the Commonwealth in November, 1935, was an "existing right" under the Commonwealth Constitution. The decision, published on Sept. 22, stated that the Gold Creek Mining Company was entitled to a patent on its Nob Fraction claim. The case was one of four test cases to determine the rights of locators of mining claims. The real point at issue, however, was whether or not claims located before November, 1935, when the new Constitution went into effect, would be administered under the Act of Congress of 1902, which is to say the freehold system, or under the new mining law which went into effect in November, 1936, which is a leasing system. The mining operators are objecting strenuously to the leasing system, chiefly because of the power it gives the government to cancel any or all leases for infraction of a multitude of regulations. The decision was received favorably by the mining industry until one governmental official announced that the case would be appealed to the Supreme Court of the United States, while administrative officers stated that their interpretation of the decision was that it established a precedent only for claims in the same category as the Nob Fraction. It so happens that all of the necessary preliminary steps, down to the

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GENERAL ELECTRIC

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Aerial view of Masbate Consolidated Mining Company's property on Masbate Island. In addition to underground mining methods, gold is recovered from a large talus deposit, employing open-cut practice shown in center background

final payment to the Government for the property. had been completed. Not more than fifteen other claims fall in the same classification. The Government maintains, and is in the position to act accordingly, that all other claims must be judged on their own merits. Mining leaders and governmental officials agree that the decision, while certainly a step toward the complete clarification of the constitution, still leaves much legal work to be done. Three other test cases are pending, involving various stages of the acquisition of a patent. As a matter of fact, the mining companies are not particularly concerned with obtaining patents; the three leading mining organizatons (Benguet, Marsman, Soriano) have between them only 67 of the 149 patented claims, and are applying for not more than 55 more. If the right to patent claims located prior to November, 1935, is established, the companies can operate their mines (since practically all of the 1,500 claims now being worked were so located) by the performance of 200 pesos' worth of assessment work annually, without the necessity of submitting themselves to the leasing system.

▶ The proposed amalgamation between the Manila and the International Stock Exchanges fell through after the former exchange vetoed the terms outlined by joint committees. At present the two exchanges are in operation, with the Manila Exchange getting more than 90 per cent of the business.

▶ Gold production for the year to Sept. 30 amounted to about 47,700,000 pesos, which is more than 10,000,000 pesos over the figures for the same period last year. Masbate Consolidated and San Mauricio have been increasing their output. Two new mills have started operation: Treasure Islands Mining Company, with a 125-ton cyanidation plant on the island of Lahuy, and Macawiwili Gold Mining & Development Company, with a 120-ton cyanide plant in the Baguio district. Both plants are using the Vandercook system of treatment. Work on the construction of a 100-ton plant for the Capsay Mining Company at Masbate, by Southwestern Engineering of P. I., is well along and operations will start in December. Southwestern is also designing a plant for the Kilometer 73 Mining Company in Surigao. A 150-ton mill is being constructed by the Elizalde interests for their Davao Gold property, in the southern part of Mindanao. Ore reserves on this property, as of July 17, 1938, were estimated to be 94,502 tons with an average value of 29.81, a total of 2,817,104 pesos.

▶ Base-metal production has declined slightly, the total value of ores exported being 588,000 pesos for September, compared to 658,000 pesos for August. Mineral Resources has suspended operations at its lead-zinc property in Marinduque, until such time as the prices of these base metals improve. Iron mining continues to dominate the base-metal industry. Two companies, Philippine Iron Mines, shipping some 65,000 tons of ore a month, and the Samar Mining Company, shipping around 15,000 tons, account for more than half of the entire output.

▶ A mining incident of considerable importance to the Philippine industry was consummated on Oct. 26, when a contract was signed by the International Engineering Corporation, Soriano technical organization, for the operation of Batong Buhay Gold Mines, Inc. The property is 150 km. north of Baguio, and has been under development for two years. Ore reserves as of September, 1938, indicate 113,490 tons, valued at 3,844,004 pesos in gold and 120,000 pesos in silver.

▶ A geological report on the Baguio district, entitled "The Geology of the Baguio Gold District," has just been published by the Bureau of Mines; it is the first technical report isued by that organization since its establishment as an independent unit by the Commonwealth of the Philippines. Similar reports on various other districts in the Islands are being planned. Dr. Charles K. Leith, of the University of Wisconsin, states in his introduction that the purpose of the report is twofold: to make a detailed study of the most productive area in the Islands which would serve as a standard column of reference for the surrounding areas and a center from which to continue geological work, and to conform to the general aim of the Bureau of Mines of making itself as useful as possible to the mining industry. The report covers the geology of the area from which about three-fifths of the Island gold is produced. Description of the ore deposits of the various companies, the structure of the vein systems, and general statistical data concerning the main operations are also given. Doctor Leith states that it is not unreasonable to surmise that many undiscovered veins exist in the vicinity of the operating mines, basing this observation on the fact that the outcrops of the veins are not strong, many of them being blind and not outcropping at all. None of the Baguio district mines showed much promise at first, and only great persistence in the face of disappointments has brought many of them into production. The report may be obtained from the Bureau of Mines, Manila, for $1 per copy.

AUSTRALIA

High-Grade Gold Ore Found at Norseman Mine

Developed ore reserves average 4 oz. gold per ton—Stacker of Wellington Alluvials resoiling gold dredge remodeled—Construction program at Mount Morgan nears completion

Western Australia

▶ Triton Gold Mines, N.L., in developing its mine at Reedy, Murchison goldfield, has intersected the lode at the No. 8 (925 ft.) and No. 9 (1,050 ft.) levels. At No. 8 it was 18 ft. wide and averaged 9.1 dwt. per ton, and No. 9 assayed 10.8 dwt. over a width of 15 ft. At both levels, widths and assays were over the mine average. The company is treating 9,000 tons monthly of 7-dwt. ore.

▶ Some phenomenally rich ore was discovered recently at the Norseman mine of Blue Bird Gold Mines, N.L., where in winzing at a depth of 60 ft. below the present bottom level (123 ft.), 150 lb. of ore yielded 530 oz. of gold. The mine, though a small one, is extremely profitable. Ore reserves developed are estimated at 5,000 tons averaging 4 oz. per ton.

▶ Southern Cross Gold Development, Ltd., a company which was floated in 1934 by the de Bernales interests, is going into voluntary liquidation. This step follows a geological examination by Dr. F. A. Moss, who was engaged to report on the mine following the failure of the ore to bulk up to estimated values.

Victoria

▶ The Harrietville alluvial area, in the Northeastern district over which Tronoh

Finance, Ltd., of London, recently exercised an option, has been proved to contain 95,000,000 cu.yd. of payable wash, according to a recent announcement. A company with a capital of £375,000 (Australian) is being formed to work the area, which will probably be equipped initially with one dredge of 350,000 cu.yd. monthly capacity.

▶ Additional production from the Chewton field should take place early in the new year when the battery of Chewton Gold Mines, N.L., now under construction, goes into operation. An orebody 25 to 30 ft. wide has now been proved from the 608 ft. to the 766 ft. level.

▶ From Aug. 1, when the company got into regular production, up to Oct. 27, Victoria Gold Dredging Company treated 381,800 cu.yd. for a recovery of 5,392 oz. gold, an average of 6.78 grains per cu.yd. The prospectus estimate for this part of the area was 6.55 grains, so that recovery has been 3.5 per cent in excess of bore values. To guard against a summer shortage of water, a borehole pump is being installed to pump water from deep drifts which occur on part of the property.

New South Wales

▶ Broken Hill South, Ltd., in the year to June 30, was, like North Broken Hill, Ltd., seriously affected by the drop in metal prices, net profit falling from £768,316 to £402,501. Working costs increased slightly, from 31/3 to 31/8 per ton. Tonnage of ore treated was 382,465 long tons, producing 69,315 tons lead concentrate, assaying 76.6 per cent lead and 29.6 oz. silver per ton, and 77,160 tons zinc concentrate, assaying 53.2 per cent zinc.

▶ North Broken Hill ore reserves at June 30 are estimated at 5,075,000 tons, an increase of 54,000 tons for the year. Prospects of discovering further ore in the older sections of the mine are considered to be promising; for example in the British section, although 139,000 tons were extracted during the year, reserves decreased by 46,000 tons only. The main orebody in the North section is exhibiting some flattening of pitch, and it is considered possible that development work may indicate that the sinking of the main shaft (No. 2) below the 2,600 ft. level may not be warranted, and that it may be necessary to sink an internal shaft from the 2,600-ft. level, 1,000 or 1,500 ft. north of the No. 2 shaft.

▶ The performance of Wellington Alluvials, Ltd., which is operating what is at present Australia's largest gold dredge at Wellington, on the Macquarie River, has improved considerably over recent months. During the 24 weeks from April 30 to Oct. 15 the dredge treated 1,467,000 cu.yd. for a recovery of 7,681 oz. gold, an average of 2.5 grams per cubic yard. Weekly working expenditure is stated to be £900 to £1,000, giving, at present rate of working, a cost of a little under fourpence (Australian) per cubic yard. In its earlier stages, the dredge encountered an unexpected difficulty in the form of heavy masses of clay, which slowed down operations and caused trouble in disposal. Furthermore, the overburden stacking gear proved unsuitable as originally designed, and had to be remodeled. Both of these troubles have now been surmounted, however, and operations are proceeding smoothly.

Queensland

▶ Mount Morgan, Ltd., during the year to June 30 considerably expanded its tonnage and obtained increased yields of both gold and copper, the figures comparing with those of the previous year thus:

Sulphide Ore

	1936/B7	1937/B8
Tons treated	322,310	375.500
Concentrate, tons	11,618	13,685
containing gold oz. (est.)	35,283	37,422
copper, tons (est.)	1,807	2,252

Oxidized Ore

Tons treated	97,241	305,458
yielding gold, oz.	4,255	19,088
silver oz.	2,736	19,661

▶ Costs of mining and treating sulphide ore totaled 12s. 4d. per ton and for oxidized ore 8s. 5d. Reserves of sulphide ore as at June 30 were estimated to be 7,126,748 tons assaying 4.24 dwt. gold and 1.79 per cent copper. Construction work on the increase of sulphide mill capacity to 10,500 tons weekly and the erection of smelting and converting plant, with accessory equipment, are expected to be completed around the end of the year.

FIJI ISLANDS

Annual accounts of the Emperor Gold Mining Company, Ltd., and of Loloma (Fiji) Gold Mines, N.L., have just been issued. The former in the year to June 15, during which the new mill was operating for five months only, showed a net profit of £63,592 (Fijian), equal to £71,541 (Australian). Ore treated totaled 128,008 tons, yielding 38,591 oz. gold, an average of 6 dwt. per ton. Present operating costs, which are regarded as normal, are 19/6 per ton Fijian currency, or 22/7 Australian. Ore reserves, at 846,600 tons, are down 60,000 tons on the year, but this was due to the fact that but little developmental work was done during the period, owing to concentration on the construction of the new mill. An extensive program is now in hand.

▶ At Loloma, from September, 1937, when productive operations began, up to July 13, ore treated was 18,036 tons, yielding 22,074 oz. gold, an average of 24.7 dwt. per ton, recovery being 87.6 per cent. This has been much improved during recent months, and for the past 28 weeks has averaged 93.4 per cent. Costs were high, totaling 66/2 Fijian currency per ton, but were subject to extraordinary expenditure incidental to starting-up troubles and should show a substantial reduction in the current year. Ore reserves, at 138,815 tons, show practically the same tonnage as last year, but average grade at 25.6 dwt. is lower, the gold content of reserves being some 9,000 oz. lower at 177,829 oz. Four new cyanide agitators were recently completed, and a scavenger flotation unit for tailings treatment is expected to be started up soon. Increased tonnage and better recovery may consequently be expected.

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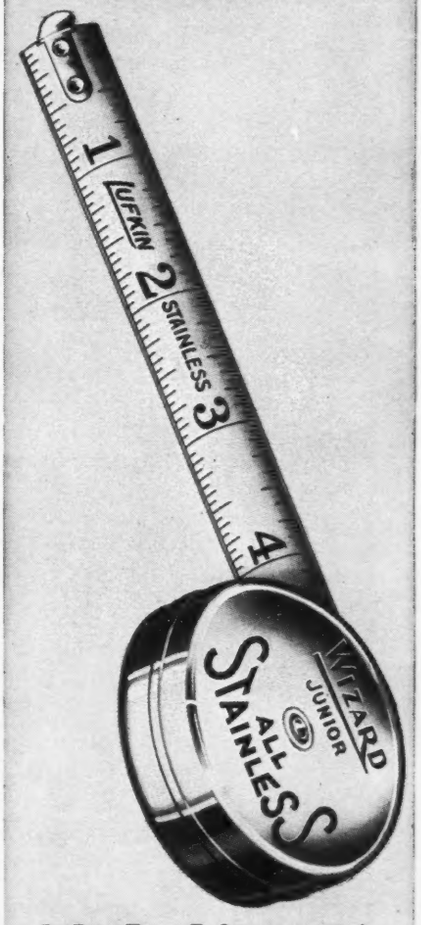

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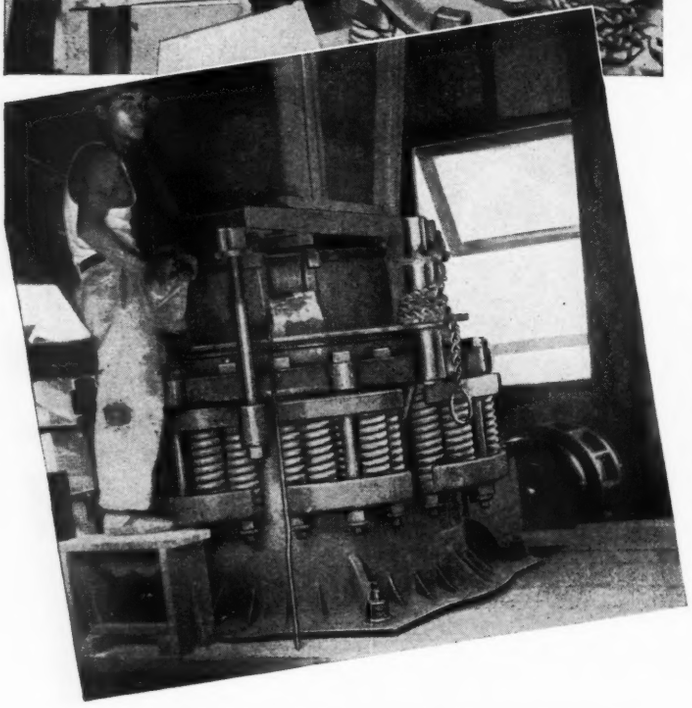

In the Philippines, as in so many of the world's more important mining fields, Symons Cone Crushers are doing the reduction crushing. Here, as elsewhere, these crushers are demonstrating their advantages in making a finer product and reducing the overall crushing and milling costs as compared with other types of equipment. At twelve of the outstanding mines on the Islands, twenty-three Symons Cones are in service.

Here, too, the original installations largely consisted of Standard type machines but, with the trend toward finer crushing as an aid to lower crushing costs and greater recovery, the tendency now is to follow these Standard crushers with Symons Short Heads. Where low grade ores prevail, this combination of Standard and Short Head Cones is often the difference between profitable and unprofitable operation. When faced with high fine crushing costs, follow the example set by the leaders of the mining industry. The predominance of Symons Cones is evidence of the service which they give.

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NEW BOOKS

AN INTRODUCTION TO METALLURGY. By *Joseph Newton, University of Idaho. John Wiley & Sons. Pp. 537. Price $4.*

COMING at a time when there is a generally recognized need for a book on general metallurgy, this volume is too brief to be considered a successor to Hofman's extensive treatise published in 1913, but it covers to some degree the same ground and brings the subject up to date; so it is sure of a welcome.

The first thing which strikes the reader is the division of the field into two parts —"Adaptive" Metallurgy and "Extractive" Metallurgy. These two terms are new and at first startling. They are descriptive, however, and perhaps worthy of a more general use. The first part covers chapters on "Structure of Metals and Alloys," "Physical Properties of Metals and Alloys," "Shaping of Metals and Alloys," "Heat-Treatment of Metals and Alloys" and "The Industrial Metals and Their Alloys." The second section includes chapters on "The Sources of Metals," "Ore Dressing," "Hydrometallurgy," "Pyrometallurgy," "Electrometallurgy," "Sampling and Related Topics," and "Production of the Industrial Metals."

Certainly the book lives up to its title and introduces the reader to all branches of the subject. At the end of each chapter are references directing attention to more complete discussions of the items covered. The use of problems and summaries is also to be commended.

Discussion of "Adaptive Metallurgy" before "Extractive Metallurgy" seems logical, for the beginner is likely to come to the subject with some information regarding metals and their properties and after rounding out his knowledge will be in better position to appreciate the importance of smelting and refining.

A hurried glance through the book gives a very favorable impression and leaves little to criticize unfavorably. The general balance in discussing the various subjects is good and the illustrations are well chosen. A more careful reading, however, leaves the impression that the author has attempted the impossible in compressing such a big subject into such a small space. The addition of about a hundred pages would have changed a very good book into an excellent book. Three instances may be selected to illustrate this point:

1. Fuels and combustion are very important in "Extractive" Metallurgy, and the twenty pages given to them are hardly adequate even for an "introduction."

2. Slags are so important in melting and refining that much more emphasis would be justified even in a brief text.

3. Refractories are important now and becoming more so as smelting rates are increasing and refining problems are becoming more difficult. A few additional pages would be welcome. Other instances of a similar nature might be mentioned to illustrate this general criticism.

It should be pointed out, however, that the author states in his preface ". . . a book such as this is the skeleton, and specialized text books are the flesh which clothes its bones; the current literature is its life's blood." A good skeleton has been put together, but, after all, an introduction to a skeleton leaves something to be desired. Perhaps when a second edition of the book is prepared the desirability of more meat on the bones will be recognized. In the meantime the skeleton will doubtless find a place on many shelves.

CARLE R. HAYWARD

OXYACETYLENE WELDING. *By R. J. Kehl, revised by M. H. Potter. American Technical Society, Drexel Ave. at 58th St., Chicago. Pp. 130. Price $1.25.*

LIKE the others of the same series—namely, "Metallurgy" and "Forging Practice," which have recently appeared—this book is written simply and with ample illustrations that aid the text in giving a practical description of the art of flame-welding with oxygen and acetylene. It has been thoroughly revised. It covers process and technique in general with subsequent specific attention to the welding of various metals, particularly steel and cast iron, malleable iron, white metal or die castings, aluminum, copper, and brass. Hard-surfacing and lead-burning also are dealt with. Cost data are given in conclusion.

COPPER MINING IN NORTH AMERICA. *By E. D. Gardner, C. H. Johnson and B. S. Butler. Bulletin 405. United States Bureau of Mines. Pp. 300. Price 40c.*

HAD THIS VOLUME been produced by a commercial publisher or by the A.I.M.E., which is also quite commercial when it turns salesman of its meritorious volumes, its introduction would have been heralded by the usual persuasive advertisements, its authors would have been accorded deserved acclaim for turning out so valuable a book, and the price thereof would have been at least $4 instead of 40c. As it is, so noteworthy a product appears unobtrusively as just another Government bulletin, one that is in danger of being almost lost to sight in the flood of Bureau literature of recent years. So it is a pleasure to rescue it and set it in what we hope is a prominent place, for readers to note.

Treatment falls into three parts: (1) history of copper mining; (2) geology of copper deposits of North America (by B. S. Butler of the United States Geological survey); and (3) prospecting, exploration, development, and mining. This last section, occupying over two-thirds of the total number of pages, is really an excellent textbook on the operations specified, with particular reference to copper—a handbook of copper mining methods, replete with specific, well-illustrated examples and supplemented by pertinent cost data and detailed analyses, prepared in the Bureau, that enhance its value. Part 2, on the geology of the deposits, is a brief summary (occupying 49 pages) dealing first with the geologic classification of the deposits and next describing in turn the copper regions and districts of the United States and of parts of Canada and Mexico, the more comprehensive and more recent reports on the district being cited in each case. The volume will be welcomed by all who get it.

TRADE ASSOCIATIONS IN LAW AND BUSINESS. *By B. S. Kirsh in collaboration with H. R. Shapiro. Central Book Company, New York. Pp. 399. Price $5.*

THIS BOOK purports to be an analysis of the problems of trade associations under the anti-trust laws. After a general introduction, the respective chapters deal with the following topics: Statistical Reporting Service. Uniform Cost-accounting Methods. Trade Relations. Standardization. Credit Bureau Functions. Boycotts and Defensive Combinations. Patent Interchange and Cross-license Agreements. Uniform Basing-point Systems. Collective Purchasing Functions. Foreign Trade Functions.

▼

PUBLICATIONS

RECEIVED

The Brown Iron Ores of Eastern Texas. By E. B. Eckel. U. S. Geological Survey Bulletin 902. Pp. 156 and maps. Sold by Superintendent of Documents, Washington, D. C. Price $1.

Attapulgus Clay. By P. F. Kerr, Columbia University, New York. Reprinted from *American Mineralogist*, May, 1937. Pp. 534–550. Also "A Decade of Research on the Nature of Clay," by P. F. Kerr. Reprinted from *Journal* of the American Ceramics Society.

Tungsten Mineralization at Oreana, Nev. By P. F. Kerr, Columbia University, New York. Reprinted from *Economic Geology*, June–July, 1938.

Occurrence of Bauxite in British Guiana. Bulletin 8. Geological Survey. Georgetown, Demerara. Pp. 68 and map Price 24c. (local currency).

Minstrels of the Mine Patch. By George Korson. University of Pennsylvania Press, Philadelphia. Folk songs, stories, superstitions, and legends of the anthracite industry. Pp. 332. Price $3.

Geologic Map of California. The new map comes in six separate sections (32x42 in.), each overlapping the adjoining sheets and carrying the legend pertaining to it. When assembled as a wall map it is 6½ x 7½ ft. In many different patterns and colors, 80 geologic formations are distinguished. Faults are also shown, and in the spacious margins of the map there are various charts showing source data, index to topographic maps, dimensions and areas of the State and its counties, index to the township and range system, a rainfall map, a geologic time chart, a geomorphic map showing submarine contours, a mineral chart, and a large master legend arranging the formations in systematic manner. Published by the California State Bureau of Mines, Ferry Building, San Francisco, Calif. Price $4 for 6 sheets.

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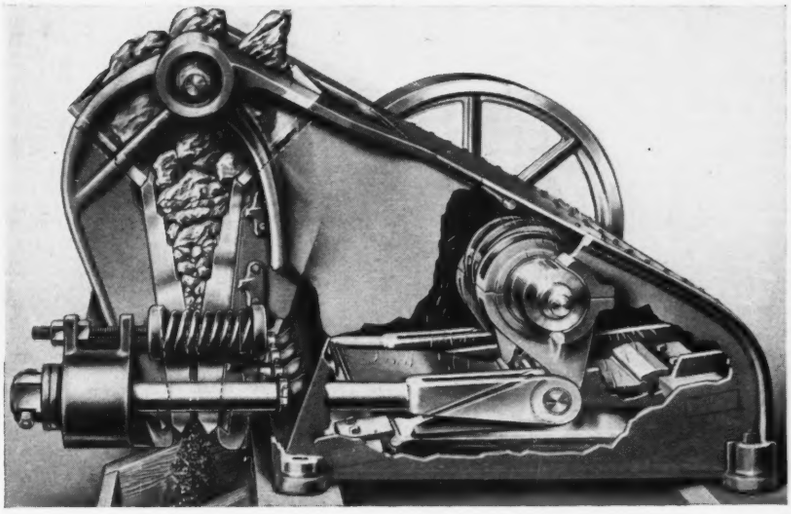
EQUIPMENT NEWS

New Jaw Crusher Of Novel Design



STRAUB Manufacturing Company, 567 Chestnut St., Oakland, Calif., recently announced the development of a novel crusher for quantity production of fine stone and ore. Introduced to the industry under the name of Kue-Ken Balanced Crusher, the new unit can produce, within limits of capacity and reduction, in a single operation, a finished product that ordinarily could be obtained only by using a primary crusher followed by one or two finishing machines. An outstanding construction feature is said to be the application of an entirely new crushing principle that employs two long, balanced pendulum jaws, each traveling a short distance and swinging toward each other in harmony. Thus, the rocks are instantly gripped and thrust down without abrasion, and are crushed and released. The upper ends of the jaws travel through a shorter distance than the lower ends, which insures the maximum leverage on the largest rock and the longest jaw travel on the large volume of smaller material at the lower end, so necessary for fast, easy crushing. As a consequence, balanced operations and increased output are possible. The operating mechanism in the streamlined, all-steel, sealed dust-proof housing consists of a sturdy steel shaft, and two outer compression pitmans with one inner tension pitman in between them as shown in the photograph. The outer ones push down, while the center one pulls up, thus balancing the entire movement. Simple and perfectly arranged oil-flooded balanced toggles give rapid approach at the start of jaw travel, and then slow down to easily crush the hardest rock. The arrangement is said to have five times the leverage of conventional motions, and flywheels are unnecessary. The compact design of the unit requires less headroom and floor space. Special rubber seals on the housing prevent entrance of grit or dust to the toggle mechanism, or the escape of lubricant. The lower part of the housing serves as an oil reservoir, with air cooling on every side and underneath. Internal cooling coils are available for operation under abnormal climatic conditions. The positive pump on the outside of the housing forces the oil to a special filter, the clean product flowing in a continuous stream through the manifold above the shaft and subsequently falling into the cooling and storage reservoir in the base. An automatic bypass arrangement makes possible lubrication while the filter is being cleaned. New features of the crushing element are the moving cheek plates, which are believed to accelerate the passage of material to the crushing zone, and the method of holding jaw plates in place on the jaw stock, which permits the plates to be worn down to minimum size. The simple adjustment device is both foolproof and readily accessible, with spacer blocks preventing unequal adjustment in side rods. These have a compensating device in the crusher housing, and changing from one product size to another is a matter of less than 3 min. Once set, adjustments are locked. Protection against tramp steel is obtained through a simple shear-pin arrangement on the drive pulley. The wide top without obstructions permits feeding of coarse and fine material from any angle, easy cleaning out of the crushing chamber, and rapid changing of jaw plates. All bearings used are of the precision type consisting of removable steel back shells with babbitt lining, and as the shafts are ground to a mirror finish no scraping or fitting is required when bearings are changed in the field. The new machine can be operated by unskilled labor.

Some Operating Results of the Kue Ken Balanced Crusher

(No. 50 Crusher; Weight, 11,000 lb., 24x9 in. opening, 365 r.p.m.)

Size and Kind of Material Crushed	Crusher Jaw Set at	Actual Power Used	Capacity in Tons Per Hour	Percentage of Minus 8 Mesh in Crusher Discharge
21 in. quartz	3 in.	13 hp.	45	2
18 in. quartz	1½ in.	16 hp.	30	5
20 in. quartz	¼ in.	35 hp.	15	37
9 in. hd. basalt	3 in.	15 hp.	60	½
9 in. hd. basalt	1 in.	25 hp.	24	¼
9 in. hd. basalt	2 in.	16 hp.	40	1
8 in. hd. basalt	⅛ in.	40 hp.	13⅓	24
4 in. hd. basalt	1¼ 56.	17 hp.	36	2
9 in. hd. basalt	½ in.	35 hp.	18	18

Permanently Sealed Ball-Bearing Pillow Blocks

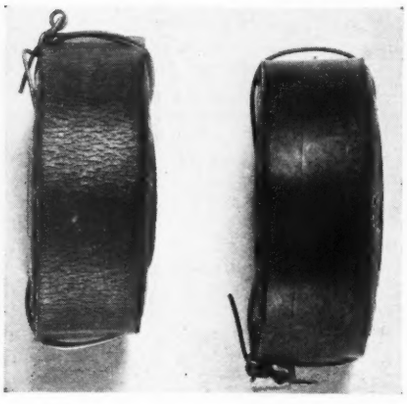
A COMPLETE NEW TYPE of ball-bearing pillow blocks has been developed under the trade name Sealmaster, by Stephens-Adamson Manufacturing Company, Aurora, Ill. Outstanding features are said to be the permanent-seal principle of the bearing, a positive, centrifugal sealing principle consisting of two inner and two outer steel seals. Inner seals, one at each side of bearing, are pressed into outer ring and become permanent part of bearing, forming a tight grease chamber for race grooves and rolling elements.

The felt liners of external seals travel in labyrinth angular grooves of inner seals and when assembled into the labyrinth groove, felts have a running clearance sufficient to prevent pressure. Centrifugal action of dished felt rings rotating in grooved labyrinth inner seals is said to prevent glazing and excludes all foreign materials. When the bearing is removed from shaft, the permanent seal feature prevents ingress of dirt, because the bearing is sealed within itself. Among other features, the pillow blocks are pre-lubricated and self-aligning.

New Tractor

A NEW GASOLINE TRACTOR, the Model "S," has been announced by Allis-Chalmers Manufacturing Company. This new machine is said to develop 77.66 hp. on the belt, 64.52 hp. at the drawbar, and 16,732-lb. drawbar pull in first gear. The constant mesh transmission provides five forward speeds from 1.52 to 6.37 miles per hour, and the constant mesh feature makes it possible to shift "on the go" like a truck. The tractor is offered in two tread widths. The 62-in. tread model has a shipping weight of 18,200 lb. and the 74-in. tread machine

weighs 19,000 lb. A new four-cylinder valve-in-head gasoline engine has been developed by Allis-Chalmers for this model. The bore is 5¾ in., the stroke 6½ in., and the governed speed at full load is 1,050 r.p.m.



A rubber compound announced by B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio, is said to increase resistance of belt covers to sunlight. The old-style rubber compound was used on the belt on the left; the other has the manufacturer's modern sun-resisting cover. Both were subjected to sunlight for many months.

BULLETINS

Crusher. Traylor Engineering & Manufacturing Co., Allentown, Pa. Bulletin 2112 describes and illustrates features of Type TY Reduction Crusher. Pp. 21.

Starters. General Electric Co., Schenectady, N. Y. Bulletin GEA-2954 describes reduced voltage A-C magnetic starters. Pp. 3. **Automatic Time Switches.** GEA-2963 illustrates features of Type TSA-14 automatic time switches. Pp. 3. **Duplex Switchboards.** GEA-2892. Folder illustrates duplex switchboards with secondary and protective equipment. Pp. 3. **Outdoor Oil-Blast Circuit Breakers.** GEA-1025B. Folder describes and illustrates moderate capacity outdoor oil-blast circuit breakers. Pp. 3.

"Welder's Trouble Shooter," Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., is the name of a pocket-size booklet listing common troubles met by welders and causes and cure for each. Pp. 8.

Dipper Tooth Repointers. Amsco Manganese Steel, 389 East 14th St., Chicago Heights, Ill. Bulletin 10C is a price list for dipper-tooth repointers and filter bars. Pp. 4.

Automatic Gas Detector. B. O. Bushnell, Los Angeles, Calif. Bulletin No. 1 describes and illustrates a detector for use wherever concentration of hydrogen sulphide, vapors, dust, or other gases must be controlled. Pp. 4.

Rotary Switches. Roller-Smith Co., 233 Broadway, New York, N. Y. Catalog 9 contains data on instrument and control switches on circuits up to 600 volts. Pp. 12.

Variable-Speed Transmissions. Graham Transmissions, Inc., 2711 North 13th St., Milwaukee, Wis. Bulletin 307 announces three new models of the manufacturers' variable-speed transmissions from 1/6 to 5 hp. Pp. 4.

Rock-Drill Lubrication. E. F. Houghton & Co., Philadelphia, Pa. Folder describes Sta-Put rock-drill lubricants. Pp. 4.

Dust Collection. Buell Engineering Co., Inc., 70 Pine St., New York. Booklet on industrial dust collection. Pp. 7. Company also issues a folder describing dust collector for recovery of gold dust from smelter-flue gases. Pp. 4.

Thermit Welding. Metal & Thermit Corp., 120 Broadway, New York, N. Y. Booklet 18C describes the Thermit welding process and its applications. Pp. 4. **Welding Rods.** Booklet 3a is a pocket-size pamphlet describing Murex welding rods. Pp. 31.

Pumps. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin 1653 describes and illustrates the company's line of close-coupled centrifugal pumps from 10 g.p.m. to 1,600 g.p.m. and for lower capacities up to 300-ft. head. Dimension sheets and useful data in figuring pump installations are also given. Pp. 30. **Pulverators.** Bulletin 1467A describes multi-impact pulverators or hammer mills. Pp. 15.

Steel Plate Lining. Ingot Iron Railway Products Co., Berkeley, Calif. Bulletin 238 describes and illustrates steel-plate linings for tunnels, shafts, caissons, and conduits. Pp. 16.

Castings. American Brake Shoe & Foundry Co., Chicago Heights, Ill. Bulletin entitled "AMSCO Alloy Heat and Corrosion Resistant Castings for Industrial Applications" contains data and illustrations on the manufacturers' alloys and their uses. Pp. 24.

Side Air-Lift Agitator. Denver Equipment Co., Denver, Colo. Bulletin 3604A describes and illustrates features of side air-lift agitator for cyanide plant and other industrial application. Pp. 2. **Suction Pumps.** Bulletin 38P8 describes and illustrates the manufacturers' diaphragm suction pumps. Pp. 2. **Thickeners.** Bulletin 3-38 illustrates and describes features of Denver thickeners. Pp. 2.

Solenoid Valves. Automatic Switch Co., New York. Bulletin 8601 is a catalog of ten sections, well illustrated, describing solenoid-operated valves for automatic and remote control of air, gas, steam, and liquids. Pp. 56.

Universal Bevel Gear. Condenser Service & Engineering Co., Inc., Hoboken, N. J. Pamphlet illustrates and describes a flexible gear device having a wide range of transmission use. Pp. 1.

Diesel Engines. Ingersoll-Rand Co., Phillipsburg, N. J. Catalog Form 10110 describes and illustrates Type S diesel engines by the manufacturer for heavy-duty, continuous-service stationary or marine-electric application. Pp. 40.

Laboratory Flotation Machine. American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. Folder 10-M describes and illustrates the laboratory Fagergren flotation machine. Pp. 4. **Reagent Feeder.** Pamphlet describes the compact Clarkson reagent feeder for reagents and solutions. Pp. 2.

Apron Conveyors. Chain Belt Co,. Milwaukee, Wis. Bulletin 332 illustrates engineering design in various types of Rex apron and pan conveyors. Pp. 6.

Safe Handling. Macwhyte Co., Kenosha, Wis. Booklet is well illustrated, showing various slings, hooks, links, and wire for lifting heavy equipment. Pp. 15.

Oil Circuit Breaker. Roller Smith Co., 233 Broadway, New York, N. Y. Catalog 6-b describes and illustrates features of "Turblator" oil circuit breaker. Pp. 2.

Vibrating Screens. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1474-B describes and illustrates Allis Chalmers new "Aero-Vibe" inclined type of suspended vibrating screens. Pp. 7.

Dust Removal System. United States Hoffman Machinery Corp., 105 Fourth Ave., New York, N. Y. Booklet contains information and illustrations for adapting vacuum cleaning units in industrial plants. Pp. 8.

Carrier Trucks. Ewell-Parker Electric Co., Cleveland, Ohio. Folder describes the manufacturer's Type IZ load carrier truck of 6,000-lb. rated capacity. Pp. 4.

Magnetic Clutches. Sterns Magnetic Mfg. Co., Milwaukee, Wis. Bulletin 225 describes and illustrates features of the manufacturer's types of "high-duty" single-disk and multiple-disk magnetic clutches." Pp. 16.

Water Purifiers. International Filter Co., 59 East Van Buren St., Chicago, Ill. Bulletin 1700 describes automatic units called Hydrodarco Purifiers used to remove objectionable tastes and odors from water. Pp. 8.

Automatic Storage Control. Stephens-Adamson Mfg. Co., Aurora, Ill. Folder illustrates and describes the Tellevel automatic storage-control device that controls level of material in bins and hoppers. Pp. 1.

Sludge Pumps. Morris Machine Works. Baldwinsville, N. Y. Bulletin 173 describes features of slurry and sludge pumps. Pp. 4.

Tractor Crane. Le Tourneau, Inc., Peoria, Ill. Folder C-606 describes use of tractor power in lifting and carrying heavy loads. Pp. 6.

Vibrating Screen. Screen Equipment Co., 9 Lafayette Ave., Buffalo, N. Y. Folder describes and illustrates features of the manufacturer's new vibrating screen having positive-controlled circular motion. Pp. 4.

Air Compressors. Sullivan Machinery Co., Michigan City, Ind. Bulletin A-22 describes and illustrates the company's Unitair stationary and semi-portable air compressors. Pp. 20.

Earth-Moving Calculator. Le Tourneau Inc., Peoria, Ill. A slide rule, available free, for computation of data on earth moving.

Photo-Visual Microscope. George Scherr Co., 128 Lafayette St., New York, N. Y. Bulletin describes and illustrates the Metaphot, a universal photo-visual microscope. Pp. 25.

Furnace Roofs. Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia, Pa. Bulletin N-33B-600B describes and illustrates the use of the Rayotube in determining temperature of furnace roofs. Pp. 12.

Wire Rope for Mining. Broderick & Bascom Rope Company, 4203 North Union Blvd., St. Louis, Mo., announces a new wire-rope catalog devoted especially to wire rope for use in the mining industry. Many pages of data as to stresses in suspended cables, stresses in shaft and incline ropes, and specific recommendations as to grades and constructions of rope for various types of strip shovels, draglines, and other equipment are included. Pp. 96.

Balanced Crusher. Straub Manufacturing Co., 567 Chestnut St., Oakland, Calif. Bulletin 600 describes and illustrates the Kue-Ken balanced crusher that reduces 10- to 16-in. rock to 1/8 in. in one pass. Pp. 8.

Heat Insulation. Quigley Co., 56 West 45 St., New York, N. Y. Bulletin 327-C-15M describes and illustrates uses of Insulay, a refractory lagging. Pp. 8.

INDUSTRIAL NOTES

E. R. Cullity, manager of the mining division of Southwestern Engineering Company, of Los Angeles, is in Manila, P. I. He will remain for four months in the Islands, where Southwestern's Philippine organization is constructing several milling plants.

Mitchell Diamond Drill Company has recently established offices at 113 Stillman St., San Francisco, Calif. Associated with the new company are B. M. and W. C. Mitchell, sons of the original founder, W. J. Mitchell, and J. J. Coen. The company will engage in setting and manufacture of bits, and contracting.

Wylie L. Graham, wire rope and tramway engineer with the American Steel & Wire Company, has been transferred from Salt Lake City, Utah, to the main office of the Aerial Tramway Department at 94 Grove St., Worcester, Mass.

Hercules Powder Company announces the appointment of J. Rex St. Clair as manager of the Wilmington office of the explosives department, succeeding J. J. Kelleher, who resigned on Nov. 11.

Walter R. Bloxdorf, metallurgist of the Macwhyte Company, Kenosha, Wis., received from the Wire Association the supreme award for the outstanding contribution to the wire rope industry for 1938.

The Osborn Manufacturing Company, of 5401 Hamilton Ave., Cleveland, Ohio, recently purchased the assets of the Johns Conveyor Corporation, of Newark, N. J., and obtained the exclusive patent rights to manufacture and sell this conveyor in the United States and its possessions.

Aerial Tramways in the Mining Industry—IV

THE TENSION in the traction cable is a minimum at the lowest point of the profile on the empty side and a maximum at the highest point on the loaded side. Tension is applied at one of the terminals, usually the lower, to keep the cable taut. Maximum tension is equal to the applied tension at the lower terminal, plus the tension component of the weight of the cable and loaded carriers, plus or minus the tension required to overcome frictional resistance on the line. Tension required to overcome frictional resistance is generally less than 1 per cent of the total and can be neglected. It is plus where the cable moves up and minus where it moves down.

Let Tm = maximum tension, that is the tension at the highest point on the loaded side
To = tension applied at lower terminal
Vl = tension component of loads
Vc = tension component of cable
Tf = tension required to overcome friction

Then $Tm = To + Vl + Vc \pm Tf$. (2)

In Fig. 8 (page 116, November issue) the discharge terminal is at the lowest point and the loading terminal at the highest point. The difference in elevation between cable supports is 10,560—9,620=940. ft. The tension component of the loaded carriers=the distributed weight per foot of the loaded carriers multiplied by the difference in elevation[3]=9.22x940=8,667 lb. The tension component of the traction cable=the weight of the cable per foot multiplied by the difference in elevation=940 w, in which w=weight of cable per foot. If frictional resistance is neglected and the tension applied at the lower terminal is 1,000 lb., formula (2) becomes

$$Tm = 1{,}000 + 8{,}667 + 940w.$$

Extra strong 6x7 Lang-lay cable, which is used on tramways, weighs 1.90 lb. per foot per square inch and has a working tensile strength of 23,600 lb. per square inch. (Determined from data furnished by manufacturers).

Let A = the cross-section area of the cable required.

Then $Tm = 23{,}600A$

and $w = 1.90A$

Substituting in the formula

$23{,}600A = 1{,}000 + 8{,}667 + 940 \times 1.90A$,

$A = 0.443$ sq. in.

If d = diameter of the cable,

$$\frac{\pi d^2}{4} = 0.443,$$

$d = 0.75$ or $\frac{3}{4}$ in.

Effect of Weight and Tension of Traction Cable—On spans at the lower end of a system where the tension in the traction cable is a minimum, most of the weight of carriers is supported by the track cable. On some of the spans higher up, the tension might be about enough to balance the weight, whereas on the spans at the upper end the tension is often enough to produce an uplifting effect on the carrier. On systems where there is a great difference in elevation between the highest and lowest points, it is difficult to avoid some uplifting effect of the traction cable at the upper end. It might be enough that there would be a tendency to lift the carriers off the track cables, but usually it is not that serious. A good empirical rule to follow is to design the system so that the sag of the empty track cable would never be more than the sag of the empty traction cable on the same span. Deflections for empty track and traction cables on any span can be calculated by finding the tension in each by formula (2) and then substituting these values in formula (1) to find the maximum or center deflection.

With overhead rollers (see Fig. 9), the cables are practically the same distance apart at the supports as at the loads, and the deflection can be calculated as if the two cables had common points of support and loading, as follows:

In formula $H = \dfrac{wmn}{2t \cos \alpha}$ (1)

H = deflection
w = distributed weight of loads per foot+weight of track cable per foot+weight of traction cable per foot
m = distance from left support
n = distance from right support
t = tension in track cable+tension in traction cable
α = vertical angle of the inclined chord.

The tension in the traction cable for any span is found by formula (2).

[3] Vertical component = Derivation of short-cut formula used / Total weight x sin. α = Weight per foot x span x $\frac{\text{Diff. elev.}}{\text{span}}$ = Weight per foot x diff elev.

Where the rollers on the towers are placed low, so that the carriers pass over them, a greater proportion of the weight of the traction cable falls on the track cable than is the case for overhead rollers. In such cases, the effect of the traction cable on the sag becomes more complicated and is the greatest at the carrier nearest the support. For flat profiles, where the tension in the traction cable is low or moderate, this effect is very slight and deflections may be calculated by considering the weight of the traction cable a part of the loading on the track cable at the carriers and calculating the deflections accordingly. On the crests of ridges, where a number of towers must be placed at close intervals or where curved rail structures are necessary, overhead rollers should always be used.

In all of the following calculations in this paper, the weight of the traction cable is neglected.

Calculations of Cable Deflections—The size of the track cable required for the loaded side has been determined as $1\frac{3}{8}$ in. in diameter. For carriers weighing 570 lb. and having a capacity of 1,200 lb. and spaced at 192 ft., the distributed loading per foot on the loaded side is as follows:

Loaded carrier—1,770÷192=9.22 lb. per foot.

$1\frac{3}{8}$ in. locked cable weighs 4.56 lb. per foot.

Total weight is 13.78 lb. per foot.

For the span from the discharge terminal to the first tower the horizontal distance is 1,400 ft.

In the formula $H = \dfrac{wmn}{2t \cos \alpha}$ (1)

H = unknown = deflection at any point.
W = 13.78 = weight per foot of cable plus the distributed load.
M = 200 = distance from point to left support.
N = 1,200 = distance from point to right support.
t = 47,000 = working tension of track cable (furnished by manufacturer).
a = 17°04′ = vertical angle from support at loading terminal to support at structure at horizontal coordinate 1,400.

$$H = \frac{13.78 \times 200 \times 1{,}200}{2 \times 47{,}000 \times \cos 17°04'} = 36.8 =$$

deflection at horizontal coordinate 200.

From this formula, deflections at each 200-ft. interval are as shown on the following page.

At Horizontal Coordinate	
200,	36.8 ft. from the inclined chord.
400,	61.3 ft. from the inclined chord.
600,	73.6 ft. from the inclined chord.
700,	75.1 ft. from the inclined chord. (center deflection)
800,	73.6 ft. from the inclined chord.
1,000,	61.3 ft. from the inclined chord.
1,200,	36.8 ft. from the inclined chord.

Since the difference in elevation of the points of support of the span from the discharge terminal to the first tower is 430 ft., the difference in elevation of points on the inclined chord at 200-ft. intervals is 430÷7, or 61.43 ft. The elevation of the cable at each interval is as follows:

Elevation of support at discharge terminal = 9,620.

At horizontal coordinate					
200,	9,620	+ 61.4	— 36.8	=	9,644.6
400,	9,620	+ 122.9	— 61.3	=	9 681.6
600,	9,620	+ 184.3	— 73.6	=	9,730.7
800,	9,620	+ 245.7	— 73.6	=	9,792.1
1,000,	9,620	+ 307.2	— 61.3	=	9,865.9
1,200,	9,620	+ 368.6	— 36.8	=	9,951.8

Corrections for Variation in Tension and Concentrated Loading—These deflections and the corresponding elevations are sufficiently accurate for all practical purposes in tramway design. They are not entirely correct, because of certain assumptions regarding the formula and the manner in which it is applied. The differences in the deflections and elevations as shown, and the true values for these quantities, are very small and are well within the allowable limits required for tramway design. The assumptions to which these differences are due are, first, the formula $H = \frac{wmn}{2t \cos \alpha}$ is the formula of a parabola, whereas the theoretical curve formed by a cable suspended between two supports is a catenary. The formula of a parabola assumes uniform loading along the inclined chord, whereas the loading is actually uniform along the curve. Second, it is assumed that the tension is the same along all parts of the span, whereas it actually increases from the lower support to the upper support, due to the cable being suspended in an inclined position. Third, it is assumed that the loading is uniformly distributed along the whole span, whereas the loading due to the carriers is actually concentrated at points 192 ft. apart on the curve.

The first of these assumptions can be disregarded entirely because deflections calculated by the parabolic formula and the catenary formula will check to within an inch, except for extremely large deflections that ordinarily would not occur in tramway construction.

Differences in deflections due to difference in tension in the track cable along the inclined span are small and unimportant, but if the true deflections are desired they can be found by correcting for tension at each point and recalculating for formula (1)

$$H = \frac{wmn}{2t \cos \alpha}$$

On the span from the discharge terminal to the first tower, the tension at the lower support on the loaded side is the applied tension of 47,000 lb. The tension at any point on this span is the tension at the lower support plus the weight of the cable per foot multiplied by the difference in elevation of that point and the lower support.

Thus, elevation at lower support = 9,620.0
elevation at horizontal coordinate 200 = 9,644.6
Difference = 24.6

Tension at horizontal coordinate 200 = 47,000+4.56×24.6=47,112.

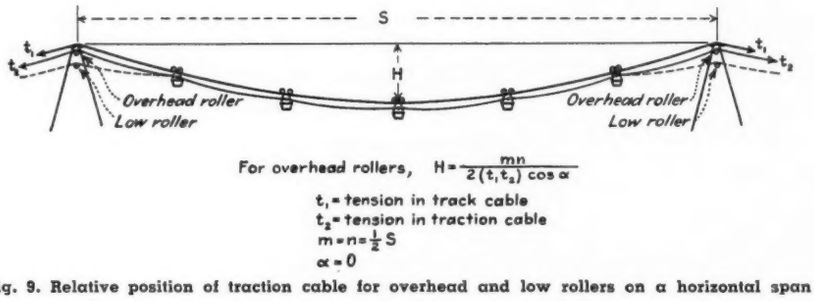


Fig. 9. Relative position of traction cable for overhead and low rollers on a horizontal span

In this way the actual tension at each 200-foot interval is found to be as follows:

At Horizontal Coordinate	
200,	47,112 lb.
400,	47,281 lb.
600,	47,505 lb.
800,	47,785 lb.
1,000,	48,120 lb.
1,200,	48,513 lb.

By using the actual or corrected tension in formula (1), $H = \frac{wmn}{2t \cos \alpha}$, the deflections at each point can be recalculated. The results of such recalculations are shown herewith, and for comparison the results of the calculations in which it is assumed the tension is constant are entered in the right-hand column.

Horizontal Coordinate	Deflections Calculated for Variable Tension	Deflections Calculated for Uniform Tension
200	36.7	36.8
400	60.9	61.3
600	72.8	73.6
800	72 3	73.6
1,000	59.9	61.3
1,200	35.6	36.8

The curve for the tension corrected at each point is slightly flatter at the upper end than the curve determined by assuming uniform tension. The maximum difference in this case is only 1.4 ft., which is well within the allowable limit of error for this feature in tramway design. On extremely long spans with steep inclination this difference may be as much as 4 or 5 ft., in which case it might be important in determining the location and height of intermediate supports.

For spans on which there are three or more concentrated loads, errors due to the assumption of uniformly distributed loading are of even less amount than errors due to the assumption of uniform tension. Formulas for deflections at points of concentrated loading have been worked out by Fred C. Carstarphen, of Denver. These formulas involve the use of the principal of second differences, which is ably discussed by Mr. Carstarphen in the publication referred to. The principal of second difference as applied to cable formulas and cable deflections is, briefly, this: The differences in the deflections at points of successive concentrated loading are variable, but the difference of these differences, or the second differences, is constant in each case.

In applying the principal of second differences, the center deflection is calculated for the loads distributed symmetrically with respect to the center of the span. The second differences and the first difference at the center loads are calculated and the rest of the deflections are found by addition and subtraction. Three formulas for deflections and one for second differences are shown here.

Case 1. Odd number of loads with one load at center of span.

Deflection at the center is

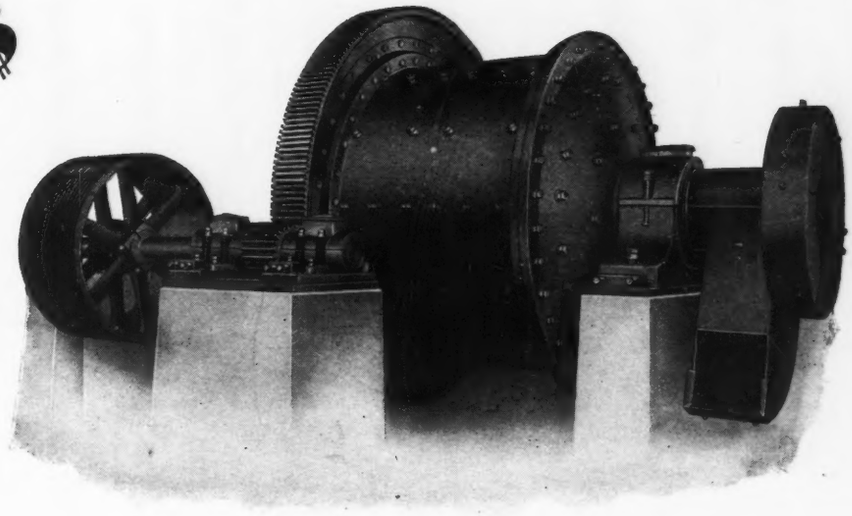
$$y = \frac{gs}{4t}\left[n - \frac{n^2 - l_q}{2}\right] + \frac{ws^2}{8t} \qquad (3).$$

In these formulas,

g = weight of concentrated load.
y = deflection from inclined chord.
n = number of loads.
s = horizontal distance between supports.
t = tension.
a = horizontal distance between loads.
$q = \frac{a}{s}$.
w = weight per foot of cable divided by the cosine of the vertical angle between supports.

(To be continued)

Excerpted from U. S. Bureau of Mines Information Circular 6948, entitled "Aerial Tramways in the Mining Industry," Part I. By O. H. Metzger.



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No wonder that thousands of other informed operators come to Allis-Chalmers, year after year. Engineering background, research, service ... get you the right equipment to do the job you want done. No other organization can give you all of this. That's why you can have confidence in Allis-Chalmers!

CRUSHING · CEMENT AND MINING DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

MINE RUN ORE at the Mascot Plant is crushed in this 30″ Allis-Chalmers Superior McCully Gyratory Crusher. Allis-Chalmers has no pet type of crusher. You'll get an unbiased recommendation of the proper crusher for your needs from the Allis-Chalmers types: **primary** gyratory, jaw, single and double roll; **secondary** gyratory, jaw, roll, and impact. And the right crusher will save you money.

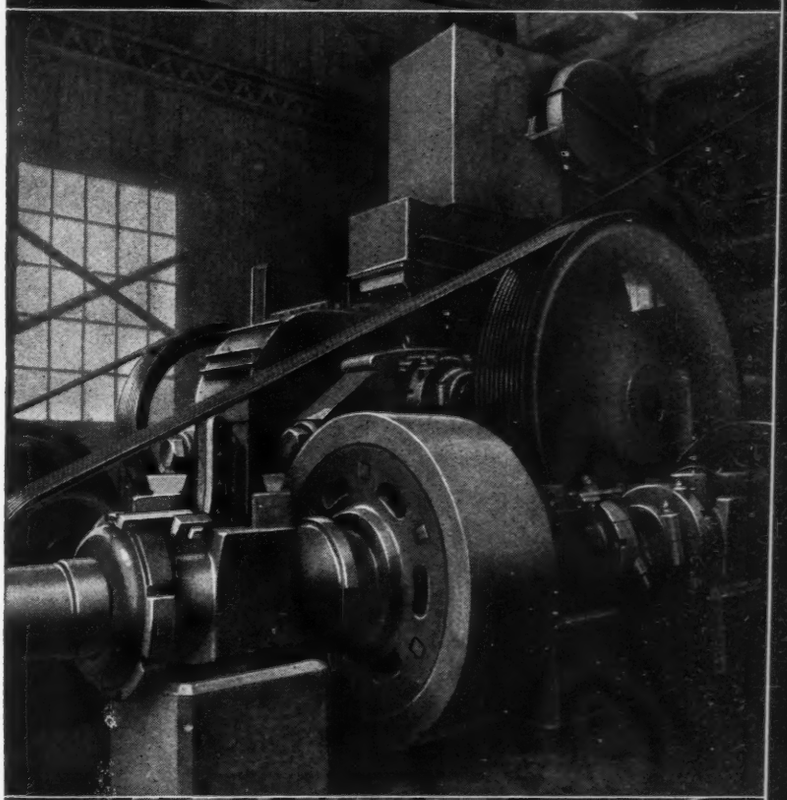
ALLIS-CHALMERS CRUSHING ROLLS handle secondary crushing in the Mascot plant of American Zinc Lead & Smelting Co. These 54″ x 20″ Allis-Chalmers "Garfield" Type Crushing Rolls are driven through 100 hp Texrope Drives.

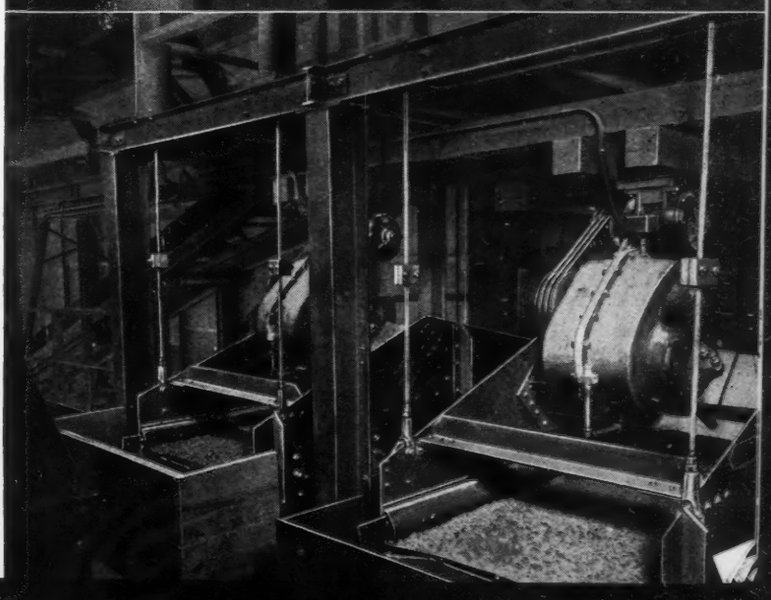
Allis-Chalmers Crushing Rolls are especially suitable for the production of ¼″ to 8 mesh material. They handle large tonnages at low cost, making a highly uniform product at less cents per ton than any other type of crusher. Allis-Chalmers builds "Anaconda," "Garfield," "Mesabi," and "XX" rolls. Diameters range from 24″ to 78″. A new 24″ x 16″ medium duty, low cost, crushing roll has been developed for economical production of sand.

THE AMERICAN ZINC LEAD & SMELTING CO. has twelve Allis-Chalmers Low-Head Vibrating screens in the Mascot plant. Among them are these two 4′ x 10′ Low-Head Screens, making ½″ separation (round holes), operating in closed circuit with 54″ x 20″ Allis-Chalmers "Garfield" Crushing Rolls. Total feed, including circulating load, is 300 T.P.H. of damp ore. Screens are driven by Allis-Chalmers Motors through Texrope Drives.

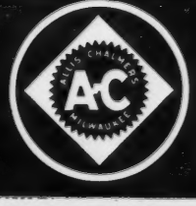
Allis-Chalmers builds four types of screen, with many sizes and variations of each for doing specific jobs. These include the "Aero-Vibe" inclined type for light and medium duty screening; "Centrifugal" inclined, positive-motion, eccentric type for maximum sizing and heavy duty work; "Low-Head" horizontal type for minimum space; and the "Utah" electro-magnetic type for fine screening. The "Utah" Electro-Magnetic Feeder handles material that must be fed at a highly uniform rate. All this equipment has been designed to save money on a particular job in your plant.

952





Allis-Chalmers also builds a complete line of equipment for Crushing, Screening, Washing . . . Concentration, Flotation, Cyanide, Treatment . . . Roasting, Smelting, Refining, and Converting Plants

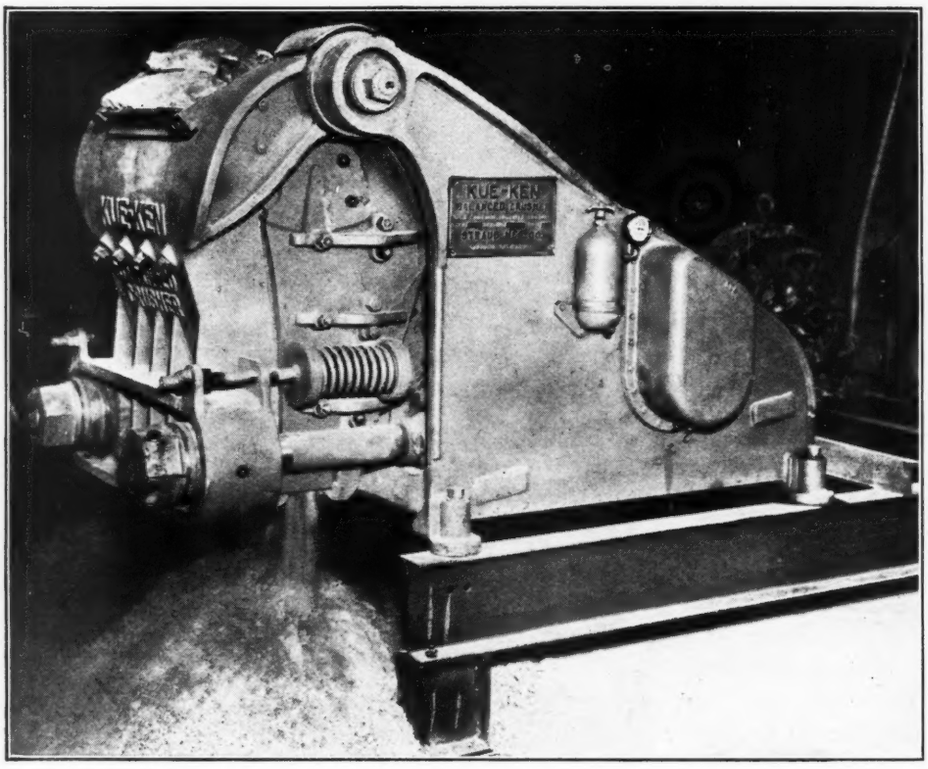


KUE-KEN BALANCED CRUSHER

USING A NEW AND BETTER PRINCIPLE, **KUE-KEN** CRUSHES FASTER AND FINER, **NO ABRASION!**

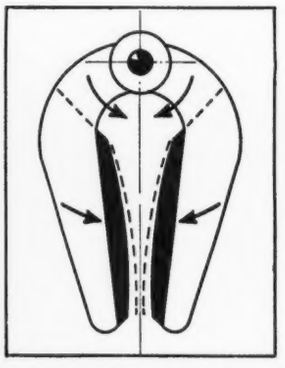
FOR MOST MILLING OPERATIONS THE KUE-KEN BALANCED CRUSHER ELIMINATES SECONDARY CRUSHERS BY DELIVERING A FINELY CRUSHED PRODUCT IN A SINGLE PASS. ALSO SAVES BINS, GATES, CONVEYORS, ELEVATORS, ETC.

KUE-KEN PRINCIPLE →



An un-retouched photo of a No. 50 Kue-Ken balanced crusher in action. This crusher is fastened to a temporary steel frame which is not bolted to the floor, proving the perfect balance.

Notice the large chunks of quartz at the mouth of the jaws. These weigh as much as 90 lbs. each, the smallest 30 lbs. They are being crushed to 1/8" jaw setting at the rate of 13 tons per hour, using 40 HP. With 3" jaw setting, the capacity is 60 tons per hour with 15 HP. And all this—without abrasion! No other crusher can equal it.



The Kue-Ken principle — see the arrows. A pair of free swinging balanced pendulum jaws pivoted at the top. They move together and downward with the rock stream, no rubbing against rock or metal. They crush *without* abrasion.

SOME OUTSTANDING ADVANTAGES

1. Ability to crush large rocks very fine in a single pass.
2. Exceptional capacity and low power requirements.
3. Perfect balance eliminates massive foundations or framing.
4. No abrasion, minimum wear, least cost per ton.
5. Simple safety device against tramp iron.
6. Simple mechanism sealed in filtered oil bath for long life.
7. Jaw setting instantly adjustable through wide range.
8. All-steel streamlined construction, strong but light.
9. Low headroom and small floor space—fits any flow sheet.
10. Moderate cost gives most crushing capacity for your dollar.

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BARE FACTS ABOUT BEAR XANTHATES

Question: Say! Every time I open one of my magazines I see your face in it somewhere. What about these Bear Xanthates?

Answer: Bear Xanthates were developed to help solve every flotation problem –

Q – Oh yeah? You'll have to be more specific if you want me to believe that!

A – Well, one of my customers floats 13,000 tons of complex copper-nickel ore per day with Bear Xanthates. Another works native gold with my reagents. And there's one that floats non-metallics – wulfenite and vanadinite – with Bear Xanthates, too.

Q – Not bad. But can't you be even more specific?

A – All right. Here's a list of some minerals Bear Xanthates are floating:

GOLD TELLURIDES
PYROMORPHITE
NATIVE COPPER
CHALCOPYRITE
ARSENOPYRITE
NATIVE SILVER
SMITHSONITE
NATIVE GOLD
PENTLANDITE
DESCLOIZITE
VANADINITE
PYRRHOTITE
SPHALERITE
ARGENTITE
WULFENITE
CERUSSITE
COVELLITE
ANGLESITE
ENARGITE
MIMETITE
BORNITE
GALENA

Q – Huh. Quite a list. And how are your Xanthates used on these minerals?

A – Lots of my customers use Bear Xanthates for bulk flotation – on lead, zinc and copper ores. Lots of others save money using my reagents for selective flotation, especially on precious metal ores.

Q – Now, don't get general again. Who are some of these users?

A – There's Alaska Juneau, and International Nickel in Canada, San Francisco Mines of Mexico, and Suyoc Consolidated in the Philippines, Trepca Mines in Yugoslavia, Roan Antelope in Rhodesia –

Q – Hey, you're jumping all over the map! I thought Xanthates would deteriorate on long hauls, especially in heat!

A – No sir! Not Bear Xanthates! I can show you 12-month stability records of all my Xanthates. Deterioration in a year's time is only 1.7% to 5.7%!

Q – Is that so? Well, how about actual performance records?

A – Okay. Alaska Juneau's flotation mill makes a profit working 75,000 tons of 30-40¢ per ton ore feed per month. Another mill increased gold recoveries 4% to a total of 98% by using a Bear Xanthate. A Pacific Coast copper property with milling costs of only 30¢ per ton has used 3 of my Xanthates –

Q – You've always got an answer! Now what can you do on this ore?

A – Offhand, I don't know. But that's why I make six Xanthates. One of them, or a combination, certainly ought to do a job even on a hypothetical ore!

Q – All right, all right! Is that all?

A – Yes, except that I'll be glad to send samples for a test run on your ore-

Z-3 Potassium Xanthate

Z-4 Sodium Xanthate

Z-5 Amyl* Xanthate

GREAT WESTERN ELECTRO-CHEMICAL CO. BEAR BRAND PRODUCTS SAN FRANCISCO CALIF.

*from Sharples Amyl Alcohols

Z-6 Pentasol Amyl* Xanthate

Z-8 Butyl Xanthate

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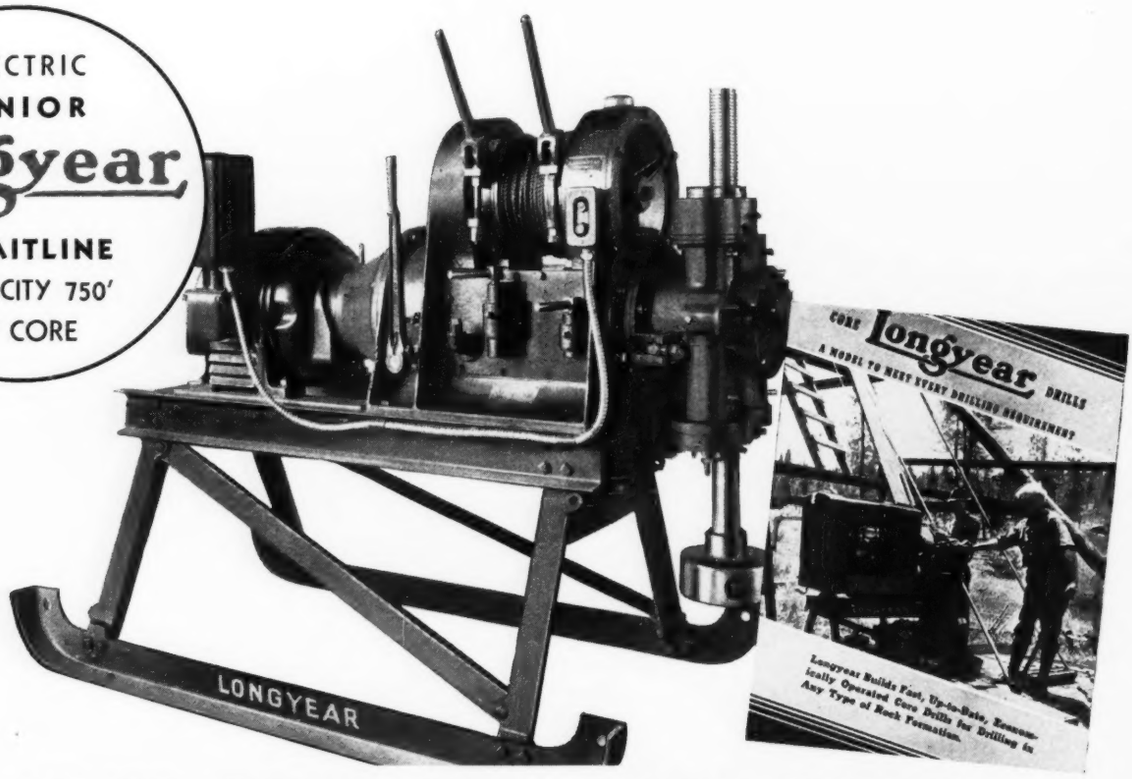
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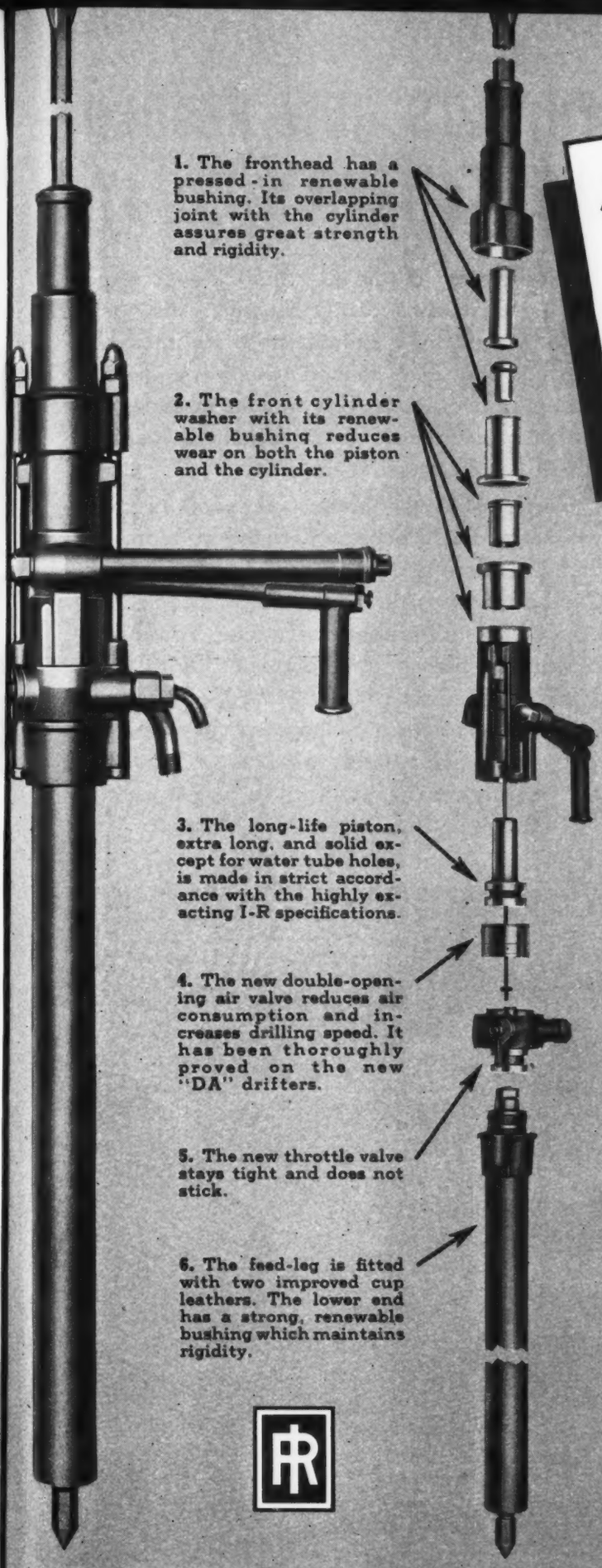

1. The fronthead has a pressed-in renewable bushing. Its overlapping joint with the cylinder assures great strength and rigidity.

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3. The long-life piston, extra long, and solid except for water tube holes, is made in strict accordance with the highly exacting I-R specifications.

4. The new double-opening air valve reduces air consumption and increases drilling speed. It has been thoroughly proved on the new "DA" drifters.

5. The new throttle valve stays tight and does not stick.

6. The feed-leg is fitted with two improved cup leathers. The lower end has a strong, renewable bushing which maintains rigidity.

A Modern HAND-ROTATED 90-LB. WET STOPEHAMER

the SA-90

1. Lower Air Consumption
2. Increased Drilling Speed
3. Smoother Operation
4. Tough, Long-Life Piston
5. A Bushed Fronthead with Overlapping Cylinder Joint
6. A Throttle Valve that does not Stick or Leak

You will find the SA-90 Stopehamer the fastest in its weight class. It stands up under hard service. Upkeep costs and air consumption are exceptionally low. Miners like it because it is so easy to handle.

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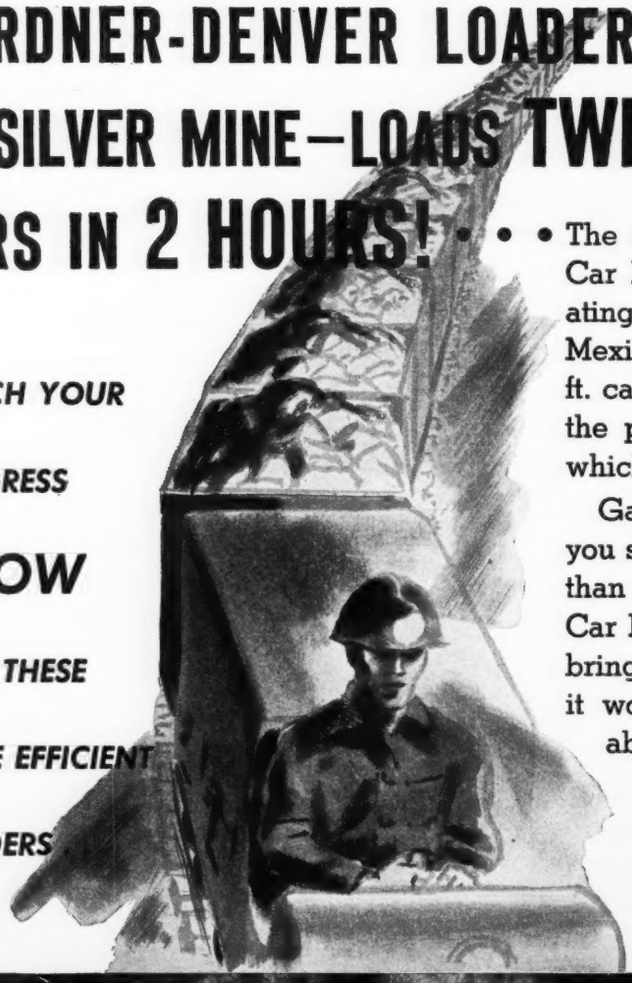
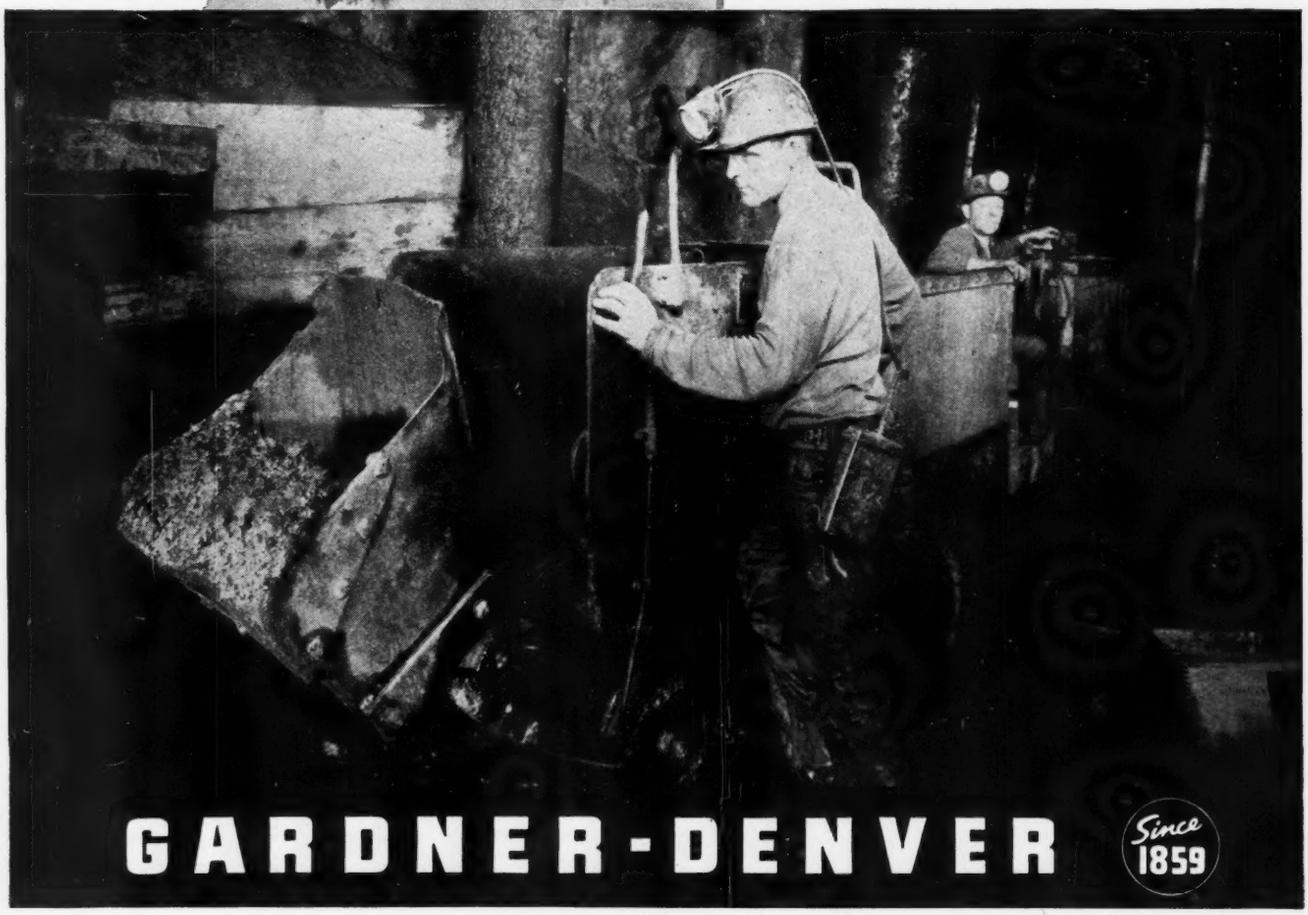
GARDNER-DENVER LOADER SETS NEW RECORD IN SILVER MINE—LOADS TWENTY-TWO 32 CU. FT. CARS IN 2 HOURS!



WATCH YOUR PROGRESS GROW WITH THESE MORE EFFICIENT LOADERS

• • • The efficiency of the Gardner-Denver Mine Car Loader was recently shown by its operating record in a prominent silver mine in Mexico. The GD-9 loaded twenty-two 32 cu. ft. cars in two hours. This was far in excess of the previous record for mechanical loading which had been set at the mine.

Gardner-Denver Mine Car Loaders give you speed PLUS economy. Using no more air than the average drifting drill, the GD-9 Mine Car Loader digs right into the muck pile and brings up a full dipper every time. You'll find it worth while to get complete information about Gardner-Denver Mine Car Loaders —and about how they can speed YOUR daily and monthly progress while lowering costs. Write for Bulletin GD-9! Gardner-Denver Company, Quincy, Ill.



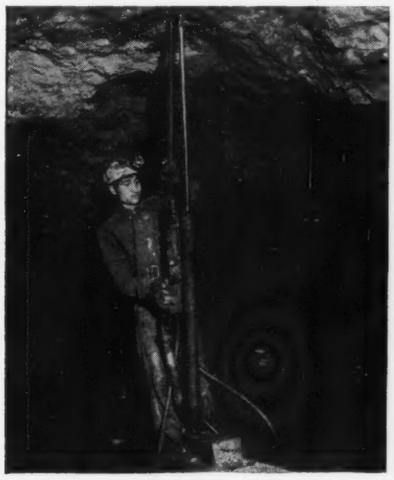
HOW THE SULLIVAN "SAFE-T-STOPER" *Promotes Safety*

The Sullivan "Safe-T-Stoper," with its exclusive self-supporting feature, promotes safety because it

1. Prevents the operator from being thrown or from being wound up in hose by a stuck steel. With the "Safe-T-Stoper" there is no twisting action of the drill due to the three point contact of drill steel, support rod and feed leg.
2. Prevents the operator from being suddenly pulled off balance by drill or struck with falling piece of steel when steel breaks. The supporting rod of the "Safe-T-Stoper" keeps the drill, drill steel and hole in alignment at all times. If a steel breaks, the drill runs up to the hole, preventing the broken piece from falling on operator.
3. Spares operator in drilling upholes because he does not have to hold machine and, therefore, can watch for falling rocks, always a hazard in stope drilling.
4. Prevents the operator from losing balance and falling from narrow timber while trying to balance drill with one hand and reach for steel with the other. The self-supporting rod of the "Safe-T-Stoper" holds drill firmly to the face and allows operator to use both hands for changing steels.
5. Prevents the drill from falling on operator when air pressure fails. The "Safe-T-Stoper," because of a check valve in the supporting rod, will remain standing even after the air is shut off.
6. Prevents careless accidents due to fatigue of operator. The self-supporting feature of the "Safe-T-Stoper" enables the drill runner to conserve his energy, thus making him more alert and able to avoid accidents.

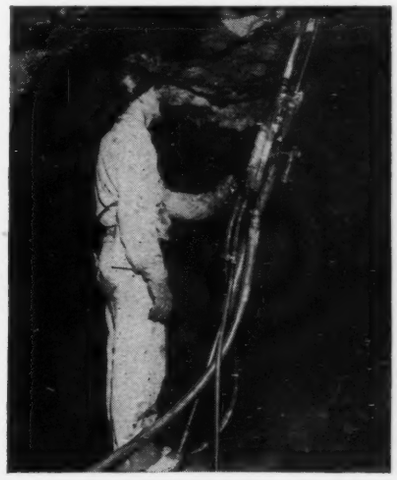
Compensation costs can be greatly reduced and working conditions made safer by installing Sullivan "Safe-T-Stopers" in your mines.

Write to Claremont for bulletin No. SS-10.



Prevents operator from losing balance while changing steels on narrow timber. A check valve in supporting rod prevents drill from falling on operator when air supply fails.

Operator does not have to hold machine while drilling. This prevents careless accidents due to fatigue and operator is also free to watch for falling rock.



Self-supporting feature prevents operator from being thrown or from being wound up in hose when a steel sticks. He cannot be pulled off balance or struck with falling steel when steel breaks.

ONLY SULLIVAN BUILDS A "SAFE-T-STOPER"

SULLIVAN MACHINERY COMPANY

CLAREMONT, NEW HAMPSHIRE

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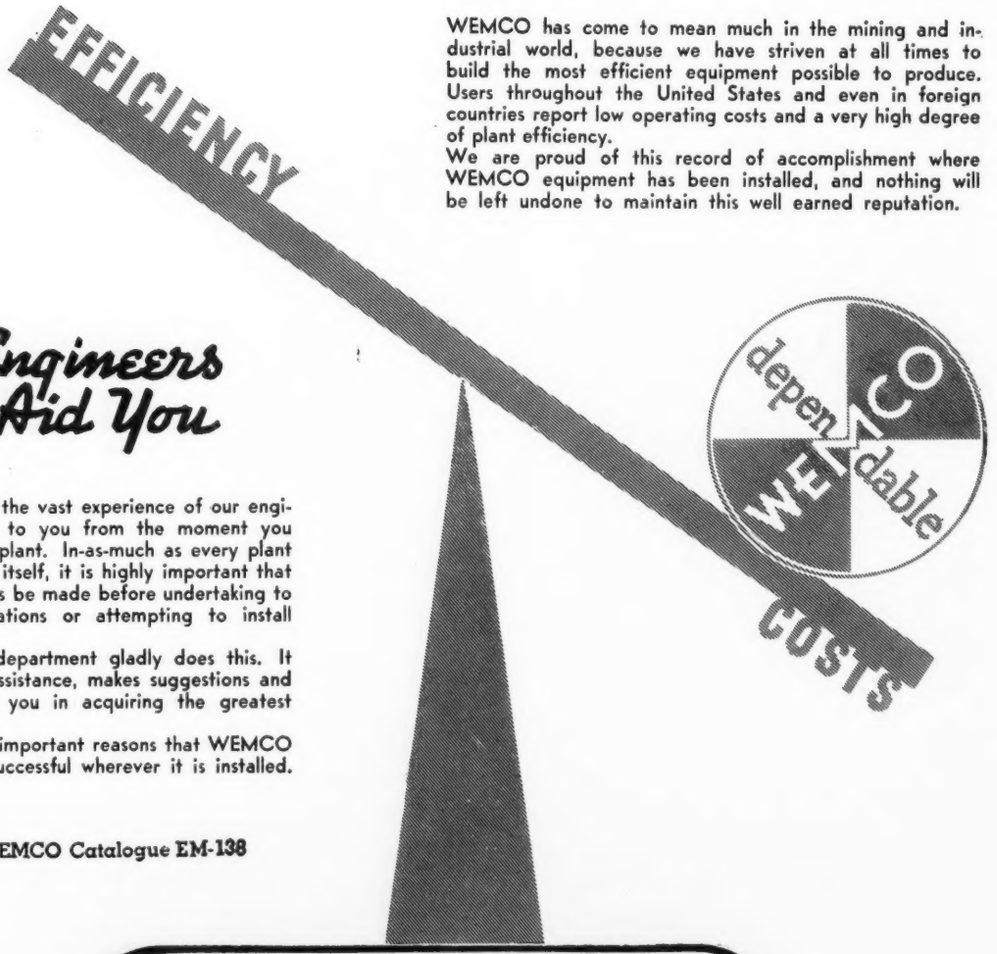
MINING MILLING & CHEMICAL EQUIPMENT

Keeps Efficiency Up and Costs Down..



WEMCO has come to mean much in the mining and industrial world, because we have striven at all times to build the most efficient equipment possible to produce. Users throughout the United States and even in foreign countries report low operating costs and a very high degree of plant efficiency.
We are proud of this record of accomplishment where WEMCO equipment has been installed, and nothing will be left undone to maintain this well earned reputation.

Our Engineers Will Aid You

The advantage of the vast experience of our engineers is available to you from the moment you contemplate your plant. In-as-much as every plant is a problem unto itself, it is highly important that a complete analysis be made before undertaking to make recommendations or attempting to install equipment.
Our engineering department gladly does this. It lends you every assistance, makes suggestions and endeavors to aid you in acquiring the greatest efficiency.
This is one of the important reasons that WEMCO equipment is so successful wherever it is installed.

Send for WEMCO Catalogue EM-138

WESTERN MACHINERY COMPANY
FOR OVER 25 YEARS A SYMBOL OF SERVICE AND SAVINGS TO INDUSTRY

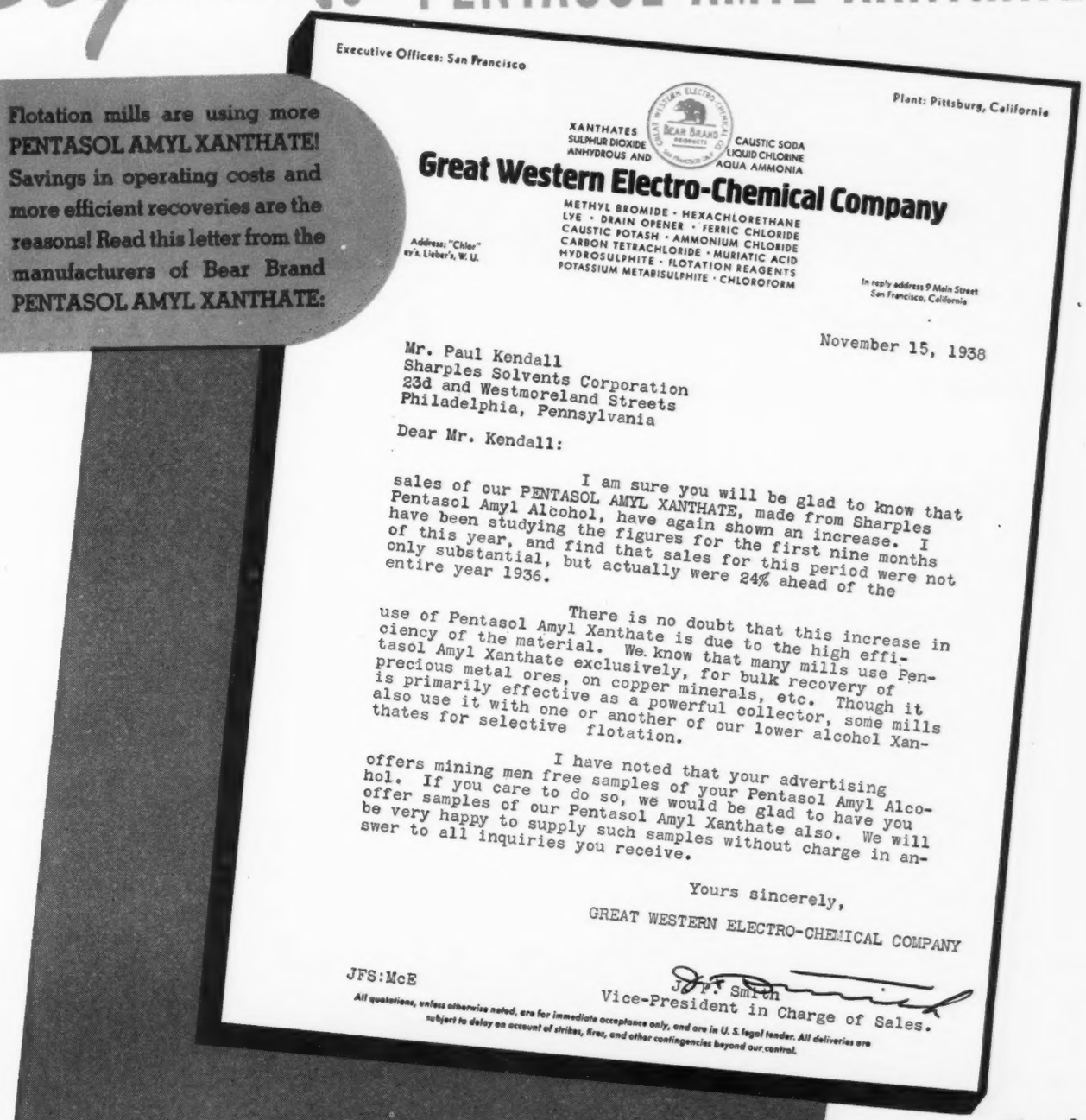
Address:
760-762 Folsom St.
SAN FRANCISCO

Philippine Agents
ATKINS-KROLL CO.
Manila, P. I.

Branch Offices—Sacramento, Salt Lake City, Denver, Phoenix, Spokane and Los Angeles...

Again! AN INCREASE IN SALES OF PENTASOL AMYL XANTHATE

Flotation mills are using more PENTASOL AMYL XANTHATE! Savings in operating costs and more efficient recoveries are the reasons! Read this letter from the manufacturers of Bear Brand PENTASOL AMYL XANTHATE:



Executive Offices: San Francisco

Plant: Pittsburg, California

XANTHATES
SULPHUR DIOXIDE
ANHYDROUS AND

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LIQUID CHLORINE
AQUA AMMONIA

Great Western Electro-Chemical Company

METHYL BROMIDE · HEXACHLORETHANE
LYE · DRAIN OPENER · FERRIC CHLORIDE
CAUSTIC POTASH · AMMONIUM CHLORIDE
CARBON TETRACHLORIDE · MURIATIC ACID
HYDROSULPHITE · FLOTATION REAGENTS
POTASSIUM METABISULPHITE · CHLOROFORM

Address: "Chlor" 49's, Lieber's, W. U.

In reply address 9 Main Street San Francisco, California

November 15, 1938

Mr. Paul Kendall
Sharples Solvents Corporation
23d and Westmoreland Streets
Philadelphia, Pennsylvania

Dear Mr. Kendall:

I am sure you will be glad to know that sales of our PENTASOL AMYL XANTHATE, made from Sharples Pentasol Amyl Alcohol, have again shown an increase. I have been studying the figures for the first nine months of this year, and find that sales for this period were not only substantial, but actually were 24% ahead of the entire year 1936.

There is no doubt that this increase in use of Pentasol Amyl Xanthate is due to the high efficiency of the material. We know that many mills use Pentasol Amyl Xanthate exclusively, for bulk recovery of precious metal ores, on copper minerals, etc. Though it is primarily effective as a powerful collector, some mills also use it with one or another of our lower alcohol Xanthates for selective flotation.

I have noted that your advertising offers mining men free samples of your Pentasol Amyl Alcohol. If you care to do so, we would be glad to have you offer samples of our Pentasol Amyl Xanthate also. We will be very happy to supply such samples without charge in answer to all inquiries you receive.

Yours sincerely,

GREAT WESTERN ELECTRO-CHEMICAL COMPANY

JFS:McE

J. F. Smith
Vice-President in Charge of Sales.

All quotations, unless otherwise noted, are for immediate acceptance only, and are in U. S. legal tender. All deliveries are subject to delay on account of strikes, fires, and other contingencies beyond our control.

PENTASOL AMYL XANTHATE is made from a blend of five Sharples Amyl Alcohols . . . and *the Amyls are the most powerful collectors of all the Xanthates.*

Have you tried PENTASOL AMYL XANTHATE on *your* ore? We will gladly send samples for test runs, either of Bear Brand PENTASOL AMYL XANTHATE or of Sharples Pentasol Amyl Alcohol from which it is made.

SHARPLES TRADE MARK SOLVENTS

THE SHARPLES SOLVENTS CORP.

PHILADELPHIA • • • CHICAGO • • • NEW YORK

Classification takes place *only in the Pool* of the classifier

and a *quiet* pool is most favorable to sharper separation—as in the AKINS

Mechanical classification is a process of overflowing ore particles which have reached a desired fineness and settling out the coarser particles to be returned for further grinding. It is therefore axiomatic that a quiet pool offers the most favorable conditions for free and proper separations to take place between different sizes of particles when settling in a liquid.

A certain amount of *uniform* agitation is desirable. The finer particles are thereby dislodged from the larger and heavier descending particles—and thus permitted to overflow.

Uniform, Gentle, Continuous Agitation

In the AKINS Classifier, sand is removed from the bottom of the pool by *spiral* motion. This action does produce agitation, but it is *uniform, gentle* and *continuous.* In the AKINS, *there is no surging or turbulence at or near the pool surface*—and thus a constant velocity and depth of flow over the weir is assured. *No other type of mechanical classifier duplicates this uniformity.*

More and more mill men are recognizing the significance of this feature in their search for better metallurgy. There are many additional reasons why AKINS Classifiers improve metallurgy, increase tonnage and lower operating costs. Here are some of them:

1. Greater overflow capacity per foot width —big saving in floor space.

2. Ability to operate at 4" in 12" slope without backslip or surge.

3. No stalling, even when overloaded.

4. Ability to produce extremely fine overflows.

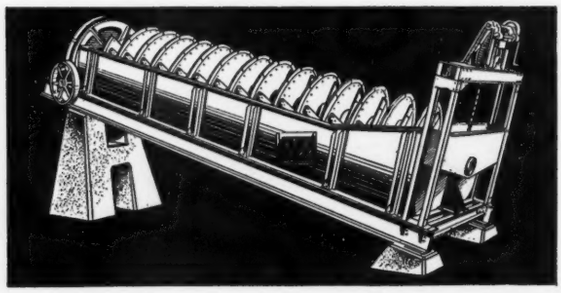
5. Efficiency at high densities.

Who is Using the AKINS?

The AKINS Classifier is not new. Earlier models have been used widely for years, but marked improvements in *recent* years are responsible for greatly increased sales to milling plants of all sizes, practically thruout the entire mining world. Buyers include many of the biggest names of the mining industry. Repeat orders constitute a large part of our business.

We also Manufacture:

Lowden Dryers; Skinner Multiple Hearth Roasters; Ore Crushers and Rolls; Ball, Rod and Tube Mills; Smelting Equipment.



***Send for* Bulletin 24-H**

This bulletin is a conservative, straight-forward explanation of the features which are responsible for the growing list of AKINS users. Read it. Then discuss your own special classification problems with our engineering department.

COLORADO IRON WORKS CO.

Main Office and Works, DENVER, COLORADO, U. S. A.

Canadian Locomotive Co., Ltd., Kingston, Ontario, Can.
Vancouver Iron Works, Ltd., Vancouver, B. C , Can.
Marsman Trading Corp., Manila, P. I.
Head, Wrightson & Co., (So. Africa) Ltd. Johannesburg
Head, Wrightson & Co., Ltd., Stockton on Tees, Eng.
The Clyde Engineering Co., Ltd., Granville, N. S. W.

UNFAILING, UNIFORM LIGHT

IN GREATER VOLUME AND BETTER DIRECTED TO THE JOB!

. . . These are the qualities that dependably serve the more than 400,000 coal and metal miners throughout the world who are today equipped with Edison Electric Cap Lamps. Let us demonstrate to YOU how you can save with the safety and efficiency provided by the Edison Lamp . . . explain our rental plan of purchase . . . and show you the popular M.S.A. Type "K" Skullgard, ideal for all-around head safety PLUS easy comfort! No obligation of any kind.

M.S.A SKULLGARDS
EDISON ELECTRIC CAP LAMPS

MINE SAFETY APPLIANCES COMPANY

Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

When Metallurgy calls for *Concentration*

WILFLEY TABLES

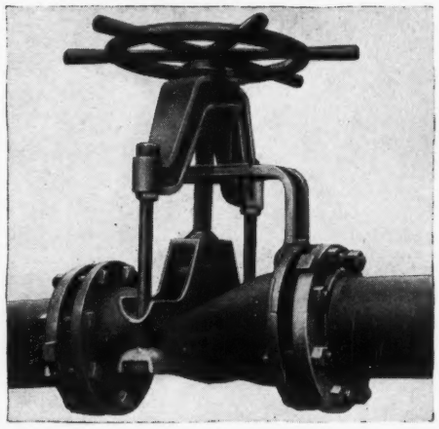
MAXIMUM results in table concentration are a matter of controlling the variable factors. Constant refinement of mechanical devices for operation, regulation and adjustment have kept the WILFLEY table in continued preference for these many years.

Individual motor drive with variable speed control permits a speed range of from 220 to 300 R. P. M. By a simple screw adjustment, stroke length may be varied from ¾" to 1¼" without reducing the effectiveness of the differential. The deck is light, but so well designed that it stays absolutely flat. Special sheet rubber provides a more satisfactory surface and longer wear.

Frames of 12" channel steel guarantee rigidity. These and many other WILFLEY features combine to produce more exact separations of both metallic and non-metallic minerals. *Write for Bulletin 64-B.*

★ **Our advisory staff is at the service of your engineers - to discuss a new plant, modernization or a single piece of equipment. *Write, wire or cable.***

New PINCH VALVE



The new Massco-Grigsby Pinch Valve was designed for more satisfactory handling of abrasive and corrosive pulps and solutions. The sleeve is made of fabric-reinforced flexible rubber, so designed as to obviate cracking when tightly closed.

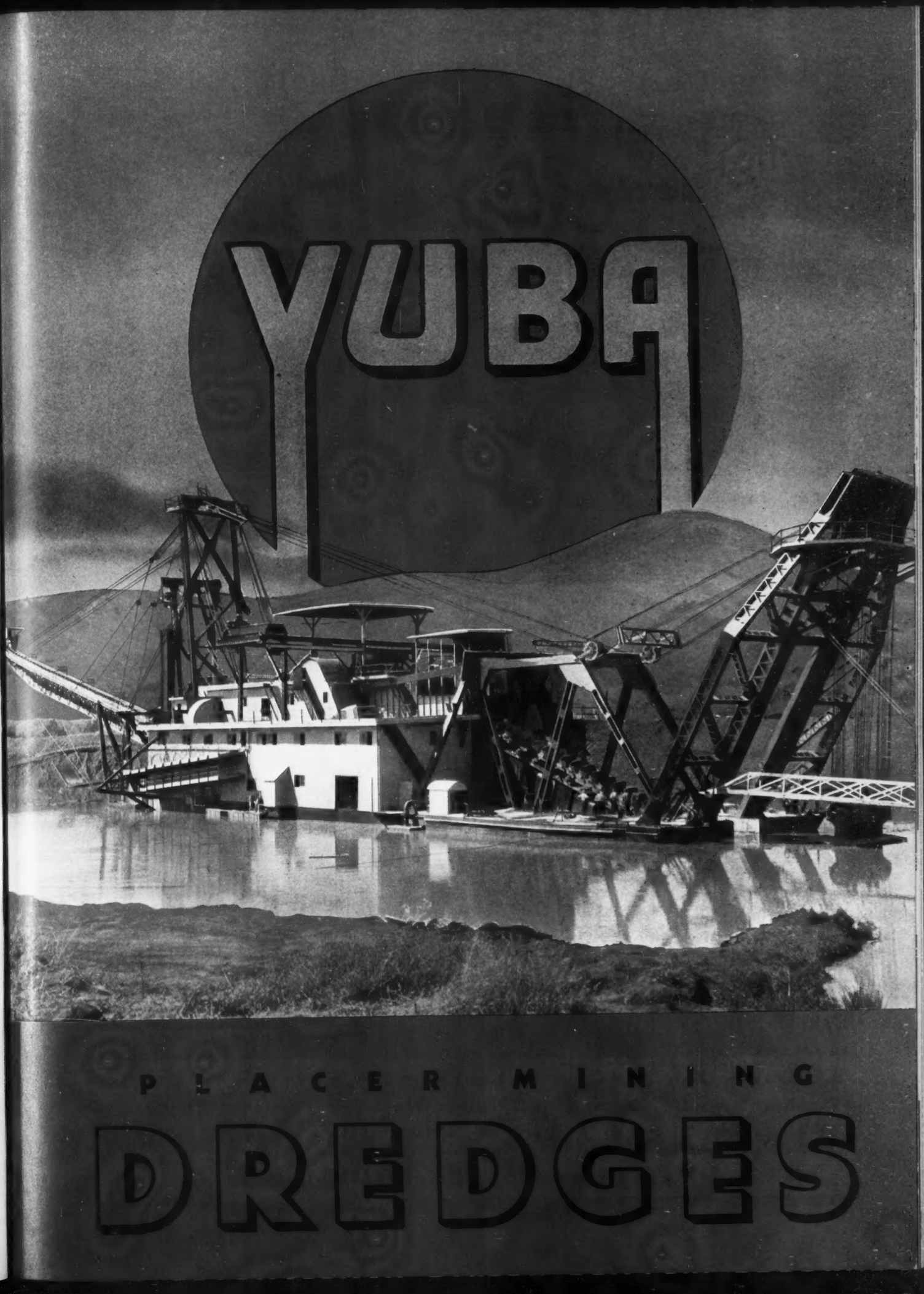
Full clearance for flow when open, thus eliminating valve friction. No bonnets or packing glands; easily operated; a long life valve. Sizes 4", 6" and 8". *Send for full details.*

El Paso - Salt Lake City - San Francisco - Seattle - New York

Canadian Vickers, Ltd., Montreal - Edw. J. Nell Co., Manila, P. I. - W. R. Judson, Santiago, Chile

The MINE and SMELTER SUPPLY Co.

Main Office, DENVER, COLO., U. S. A.


YUBA
PLACER MINING
DREDGES

The Story of Modern

DREDGE MINING

Yours for the Asking...

• A new 32-page illustrated book has been printed to record the story of Yuba and its contribution to the dredge mining industry of the world. Pictured and described therein are many recently built Yuba dredges operating in Alaska, California, Chosen, Colombia, Idaho, Malaya, Montana, U. S. S. R., Yukon, and elsewhere, all demonstrating their superiority and dependability.

Shown also are informative bits of detail that add to the story and explain visually the reason for Yuba's claim to over 30 years of continuous experience and from which 53 modern Yubas have been designed and built in the past 10 years. Yuba No. 137 is now under construction.

Dredges for Gold, Platinum, Tin—Dredges flown to their placer fields in small units—Dredges being towed to destination—Dredges operating in snow and thawed ground—Dredges with portable pontoon-type steel hulls and superstructures for quick erection—Deep-digging Dredges—Wood hull and Steel hull Dredges—Dredges displacing from 200 tons to 3500 tons—each one built to fulfill specific requirements—every one built in Yuba shops or directly under Yuba supervision.

On the back of this page is a reproduction of the cover of our new book in which you may find pictured a dredge working and overcoming problems similar to those confronting you. 32 pages of placer dredge information prepared for your use. Dredgemen throughout the world will want a copy for reference. It will make a valuable addition to the mining engineers' book-shelf. Libraries are especially invited to write for copies. A letter or postcard will bring this interesting story of dredge mining. Write for your copy. No obligation, of course.

YUBA MANUFACTURING CO.

351 California St. San Francisco Calif.

Cable Address-Yubaman, San Francisco-Yardage, London

YUBA DREDGES — PROVED DEPENDABILITY ROUND THE WORLD

6 TO 15 TIMES LONGER LIFE

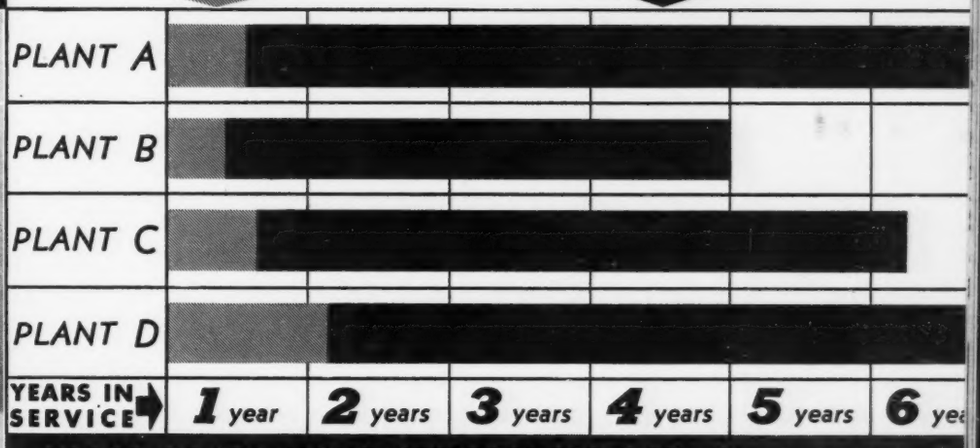
WITH THESE DENVER-GOODYEAR

Molded Rubber Parts

Added LIFE with DENVER MOLDED RUBBER PARTS

LIFE HARD IRON

LOWEST OPERATING COSTS ARE OBTAINED AT THIS MILL WITH MOLDED RUBBER PARTS



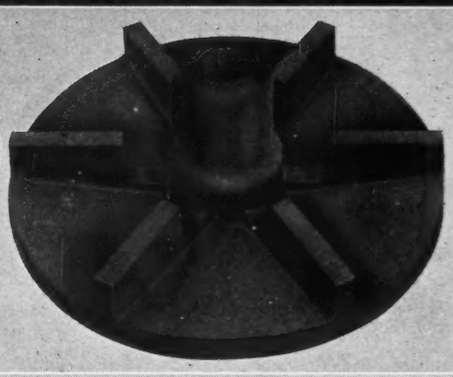
CRUDE RUBBER COMPOUND APPLIED TO SPECIAL METAL CORE READY TO BE PLACED IN MOLD

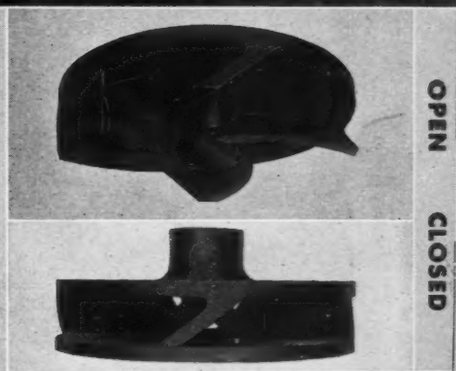
YEARS OF "24-HOUR SERVICE" PER DAY without attention . . . . . maintenance costs reduced to the vanishing point . . . lower horsepower . . . lighter weight . . . perfect balance . . . these are focal points of Denver Pressure-Molded Rubber Parts.

10,000 of these have been placed in every kind of service since 1932. The Denver Equipment Company pioneered this development "when it couldn't be done."

Pressure-molded rubber parts . . . another reason why Denver "Sub-A" (Fahrenwald) Flotation Machines are standard the world over.

WRITE FOR BULLETIN 38F13 GIVING ALL FACTS





MOLD CONTAINING IMPELLER BEFORE CLOSING FOR HEAT CURING IN HYDRAULIC PRESS

PRESSURE-MOLDED RUBBER DENVER "SUB-A" IMPELLER AFTER BEING REMOVED FROM MOLD

M. S. IMPELLERS ARE MADE IN BOTH OP AND CLOSED TYPES - SIZES 18", 21", AND 2

NEW YORK CITY, NEW YORK: 50 Church Street
SALT LAKE CITY, UTAH: McIntyre Building
TORONTO, ONTARIO: 45 Richmond Street West
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DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

MEXICO, D. F.: Boker Bldg., 16 de Septiembre, 58
SANTIAGO, CHILE: Clasificador F-485
MELBOURNE, AUSTRALIA: 360 Collins Street
JOHANNESBURG, SO. AFRICA: Bon Accord Hse.

DENVER EQUIPMENT COMPANY

1400 SEVENTEENTH STREET, DENVER, COLORADO

COMPLETE! IS GALIGHER'S METALLURGICAL SERVICE

backed by 35 years' experience that is available to YOU through our:

THERE IS NO SUBSTITUTE FOR EXPERIENCE AND SERVICE

METALLURGICAL STAFF of competent recognized metallurgical engineers. This broad experience in the field of ore-treatment, permits successful correlation of laboratory results and plant operation.

METALLURGICAL ORE-TESTING LABORATORY which aims to derive an economical and practical treatment of your ores. Since our laboratory has modern equipment which includes BOOTH-THOMPSON LABORATORY AIDS*, we can give a correct solution to *your* problem—whether gravity, amalgamation, flotation, cyanidation or a combination of methods is required.

*"PILOT PLANT" AGITAIR FLOTATION MACHINE—LABORATORY BALL MILL AND DRIVING UNIT—LABORATORY PRESSURE FILTER—LABORATORY VACUUM FILTER—LABORATORY AGITAIR.

MILL DESIGN CONSTRUCTION and OPERATING SERVICE assures you of a successful installation. Our experience shows a plant designed for YOUR requirements as established by test work, will equal or exceed test results.

GALIGHER'S OTHER PROFIT-MAKING PRODUCTS INCLUDE: GEARY REAGENT FEEDERS—GEARY-JENNINGS SAMPLERS—AGITAIR FLOTATION MACHINE—BEE-TEE TILTING FILTERS—BATEA CLEAN-UP AMALGAMATION PANS—AMALGAMATION CLEAN-UP BARRELS and PILOT PLANT EQUIPMENT.

THE HOUSE OF GALIGHER thanks its friends for the very pleasant business relations enjoyed during 1938 and extends heartiest wishes for a MERRY CHRISTMAS and HAPPY PROSPEROUS 1939.

LET US PASS THE RESULTS OF THIS EXPERIENCE ON TO YOU

Foreign Representation—SOUTH AFRICA—G. H. Langler & Co., Ltd., 249 Main St., Johannesburg. MANILA, P. I.—Earnshaws Docks & Honolulu Iron Works. GREAT BRITAIN—Hosking & Hylton, 100/c Blackstock Rd., Finsbury Park, London, N. 4

BOOTH-THOMPSON DIVISION · ENGINEERING SERVICE

THE GALIGHER COMPANY

228 SO. W. TEMPLE ST. (Established 1901) SALT LAKE CITY, UTAH

BOOTH-THOMPSON DIVISION

WHY YOU GET MORE TONNAGE *with* INDEPENDENT CENTERING!

One of the Sullivan Loaders operating in the largest copper mine in the state of Montana.

Again Sullivan Loaders point the way to extra tonnage in modern mine car loading—proving the value of INDEPENDENT CENTERING, that EXCLUSIVE FEATURE FOUND ONLY ON SULLIVAN MINE CAR LOADERS.

INDEPENDENT CENTERING, the horizontal swing of the bucket before discharge into car, gives to Sullivan Loaders that flexibility of "the-shovel-in-a-mucker's-hands," the ability to throw the muck straight and fast to any point in the car—without spillage—even on the sharpest curves.

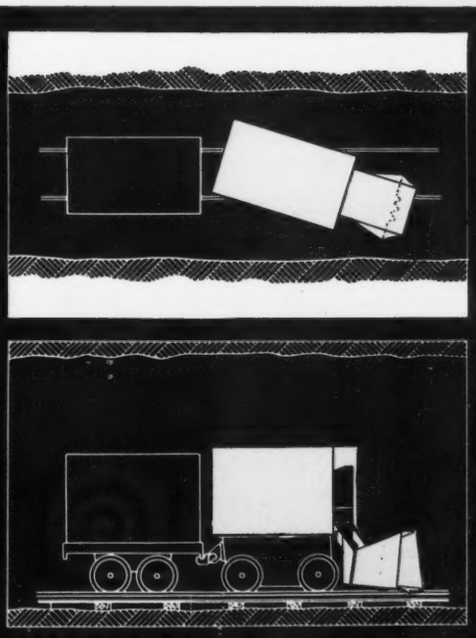
CENTERING of the rocker arm and bucket is done AT THE WILL OF THE OPERATOR and works INDEPENDENTLY OF THE ROCKER ARM loading swing to give the two important features of (1) POSITIVE CENTERING for loading on a straight track or (2) POSITIONED CENTERING for loading on a curve.

INDEPENDENT CENTERING also gives such EXCLUSIVE ADVANTAGES as (a) FAST CENTERING the moment the bucket clears the muck with no "slow motion loading" at point where centering starts, (b) SMOOTH CENTERING with little shock to the operator and no rebound of rocker arm from side to side, (c) POSITIVE CENTERING with no chance for rocker arm to pass center at any point in the loading cycle and (d) practically frictionless centering with no cams, guides, etc., to absorb needed power.

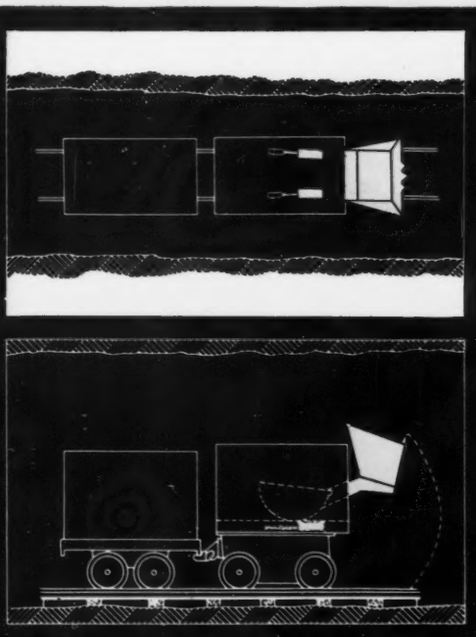
All these advantages allow a long, fast, upward swing of the rocker arm and bucket to load more tonnage at low per-ton cost.

Write to Claremont or nearest branch office for copy of bulletin 76-L describing the Sullivan mine car loader.

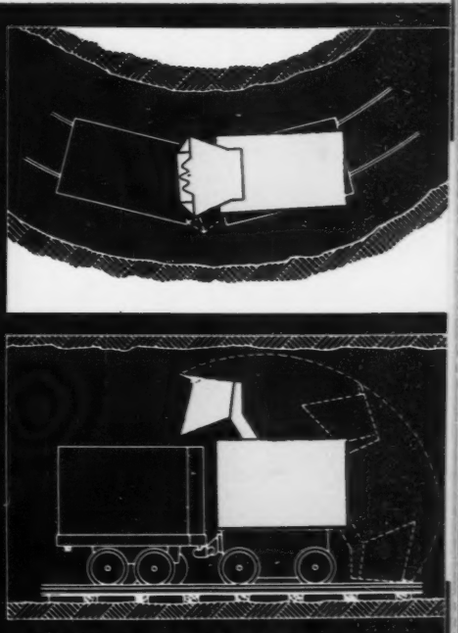
SULLIVAN MACHINERY COMPANY
CLAREMONT, N. H. — MICHIGAN CITY, IND.



CENTER CROWDING ACTION forces rocker arm assembly to the center point the moment the bucket clears the muck. This allows a long, fast rocker arm loading swing to speed loading of longer cars.



Positive locking-plunger and two sturdy centering cylinders control the flexible loading swing of the rocker arm and bucket. Manual centering obtained by using thumb to press small button on top of digging lever.



POSITIONED CENTERING allows fast centering and dumping of bucket into center of car on a curve. Note position (upper view) of bucket (dotted lines) when centering with mechanical positive centering devices.

BUILT FOR THIS JOB

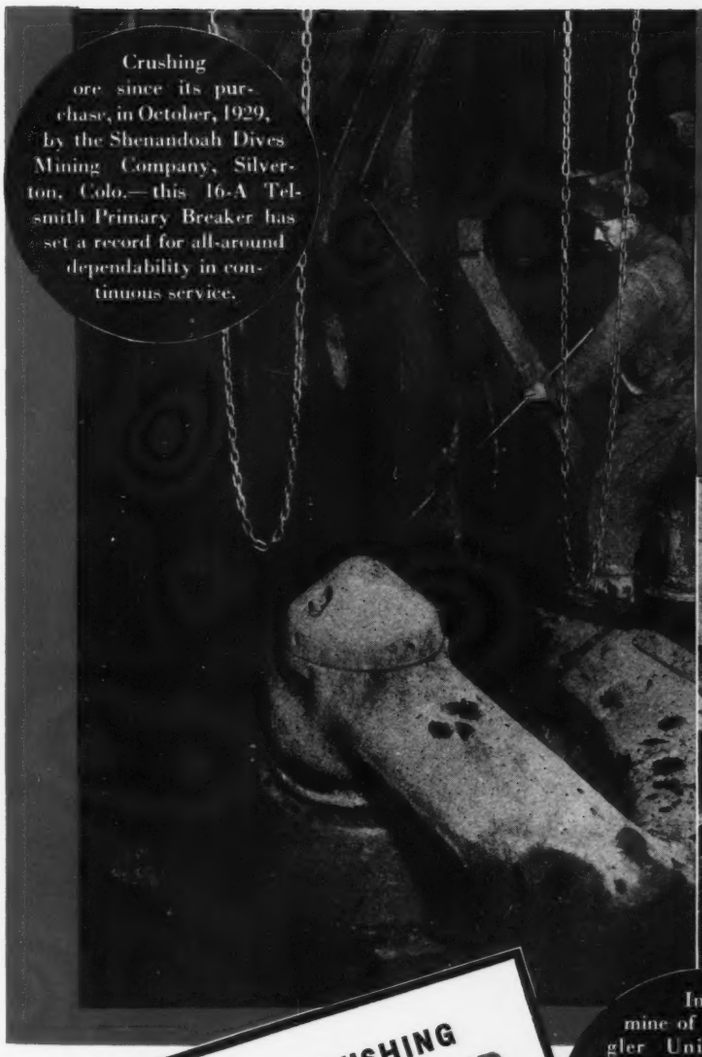
THE specific requirements of this Philippine Islands placer dredging job—digging and treating heavy clay and working in a seaway — determined the design and construction of Bucyrus-Erie's d-edge No. 319, shown here. Since 1891 every placer dredge built by Bucyrus-Erie has been job-designed and job-fitted for maximum output and lowest cost per cubic yard of excavated material—for dependable and profitable mining performance. The modern Bucyrus-Erie dredge is the product of wide engineering experience gained from continuous close cooperation with world's leading placer mine operators, and the superior manufacturing facilities developed by world leadership in building quality excavating equipment. Consult us about *your* dredging problem.

BUCYRUS ERIE

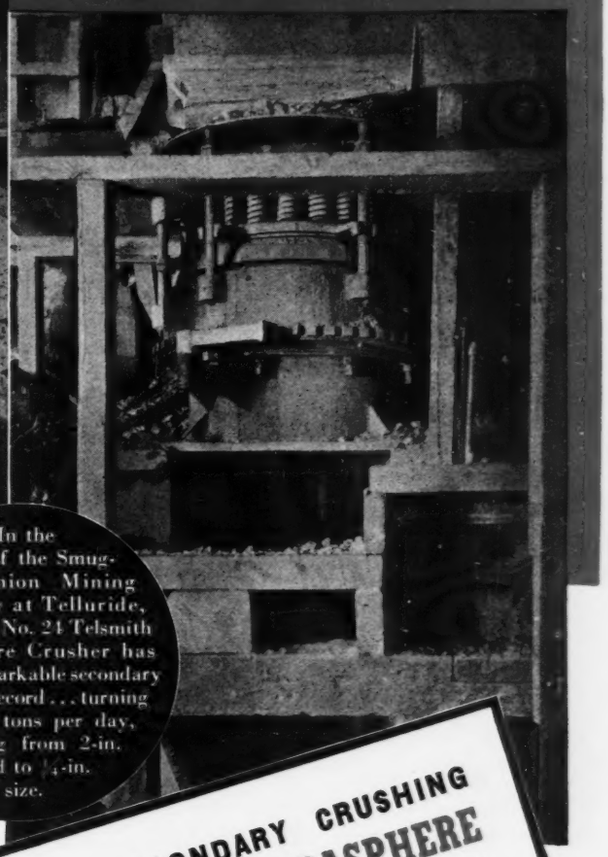
BUCYRUS - ERIE

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

TELSMITH
FOR Tonnage



Crushing ore since its purchase, in October, 1929, by the Shenandoah Dives Mining Company, Silverton, Colo.—this 16-A Telsmith Primary Breaker has set a record for all-around dependability in continuous service.



In the mine of the Smuggler Union Mining Company at Telluride, Colo., this No. 24 Telsmith Gyrasphere Crusher has made a remarkable secondary crushing record . . . turning out 430 tons per day, crushing from 2-in. feed to ¼-in. size.

FOR COARSE CRUSHING

TELSMITH BREAKER

a short compact crusher with a fixed shaft and sleeve eccentric; super-strong steel frame and crown and unbreakable shaft. Cut steel drive gears and force feed oiling permit higher eccentric speeds and faster gyration. Larger head and concave diameters, with greater receiving and crushing area, allow faster feeding. Telsmith's *parallel pinch* starts immediately, crushes full tilt all the way down; guarantees bigger capacity. *Write for Bulletin B-1.*

FOR SECONDARY CRUSHING

TELSMITH GYRASPHERE

takes an unregulated choke feed, and turns out an enormous tonnage with less expense for power and maintenance. With its spherical crushing head, impelled both by the gyrated shaft and the rotary wedge action of the supporting eccentric, its crushing action is the most effective ever devised. The Telsmith Gyrasphere Crusher not only crushes finer, but the product contains fewer over-size slabs and splinters. *Write today for Bulletin Y-1.*

Min-2-38

EXPORT OFFICE: 770-A Hudson Terminal Bldg., New York City

50 Church Street, New York City — 201 N. Wells Street, Chicago, Ill. — 713 Commercial Trust Bldg., Philadelphia, Pa. — Mines Eng. & Equip. Co., San Francisco, Calif.

General Agents for Western States: Mine and Smelter Supply Co., Denver, Salt Lake City, El Paso

Associates in Canada: Canadian Vickers, Limited, Montreal and Vancouver

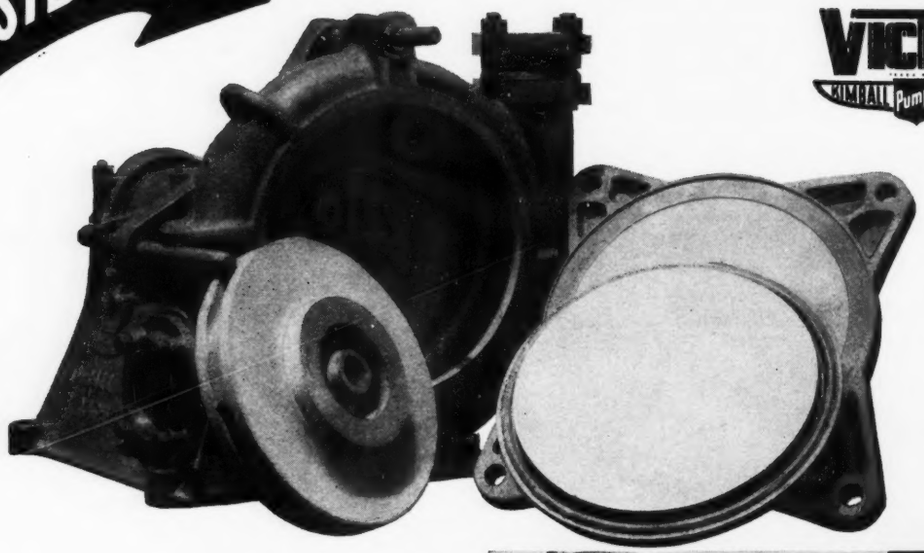
Eng. Equip. & Supply Co., Manila, P. I. — Samuel Osborn (S. A.) Ltd., Johannesburg, So. Africa

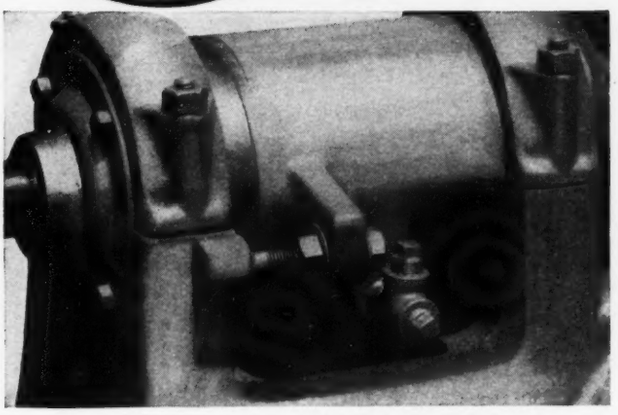
SMITH ENGINEERING WORKS, 807 E. CAPITOL DRIVE, MILWAUKEE, WIS.

HERE'S ACCESSIBILITY

that cuts shutdown time.. ..Reduces maintenance cost

VICTOR
KIMBALL Pumps KROGH





Illustrated above is the Victor-Kimball-Krogh wear take-up adjustment which is instantly accessible and quickly adjusted.

WHEN wear hits this sand and tailings pump—as it does all pumps carrying abrasives—it won't tie you up. The Victor external wear-take-up adjustment makes compensation for wear a simple matter.

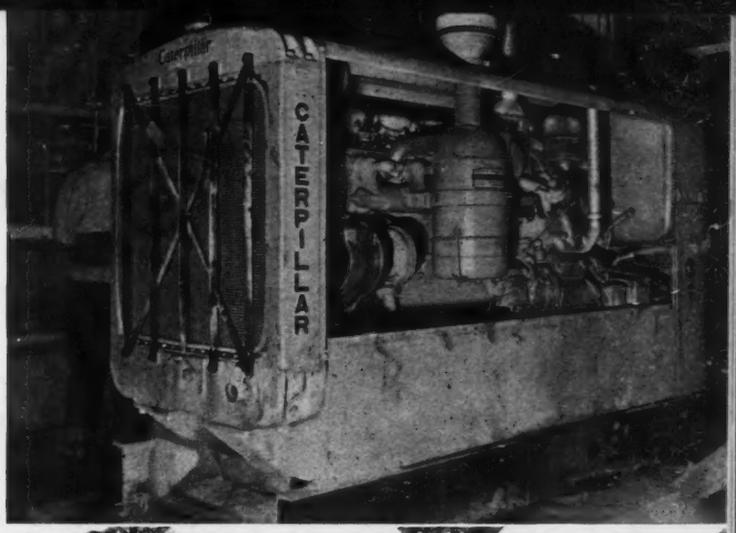
And, when replacement of worn parts is necessary—removing 4 nuts provides instant access to all wearing parts in the Model "M" Pump. No special tools are needed to reach the front liner and impeller which can be replaced by any mill mechanic in remarkably short time. Pump "outage" is held to a minimum.

The volute is replaced in the same manner. Instead of a bulky, cumbersome liner, the special abrasion resisting volute — low in cost and quickly replaced—acts both as liner and pump casing. This, too, saves shutdown and maintenance time.

Designed to provide more satisfactory service at lower cost, the Model "M" answers your sand and tailings pumping problem. Why not get Bulletin 325 which contains more facts on how this pump can reduce your pump operating costs?

VICTOR EQUIPMENT COMPANY
KIMBALL-KROGH PUMP DIVISION
1010 EAST 62nd STREET
LOS ANGELES, CALIF.
515 HARRISON STREET
SAN FRANCISCO, CALIF.

THE MILL goes to the MOUNTAIN



BECAUSE "Caterpillar" Diesel Engines are exceptionally dependable, it is no longer necessary for ore mills to be located near some distant source of power. . . . They can be located near mine or dredge — to effect substantial savings in ore-hauling costs.

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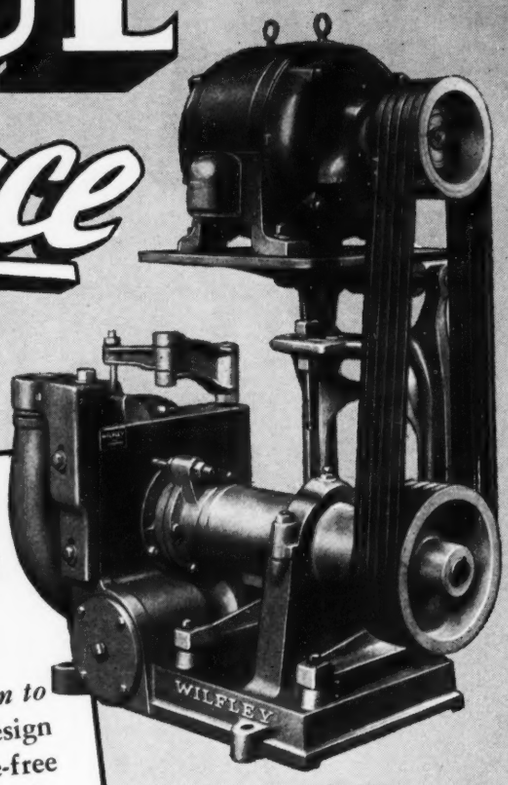

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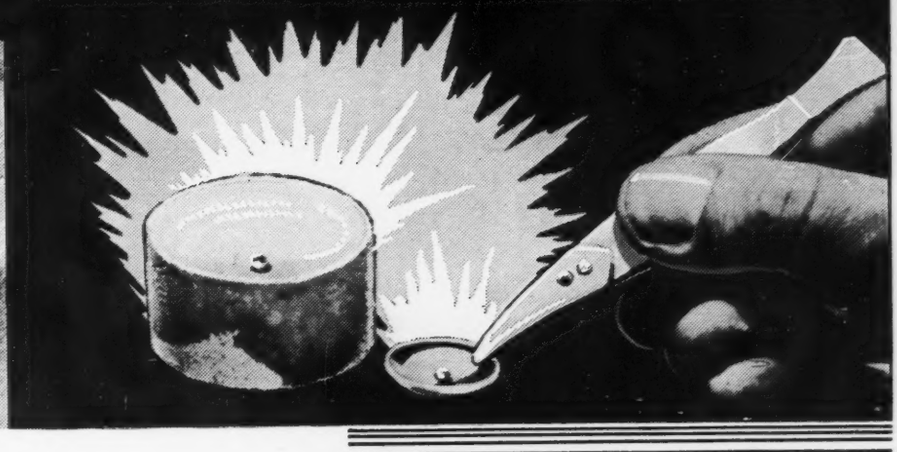

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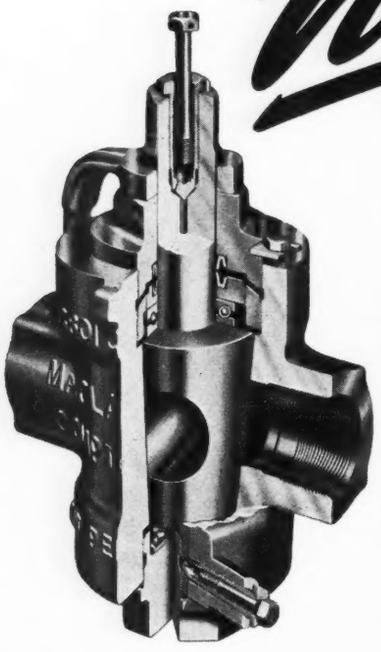

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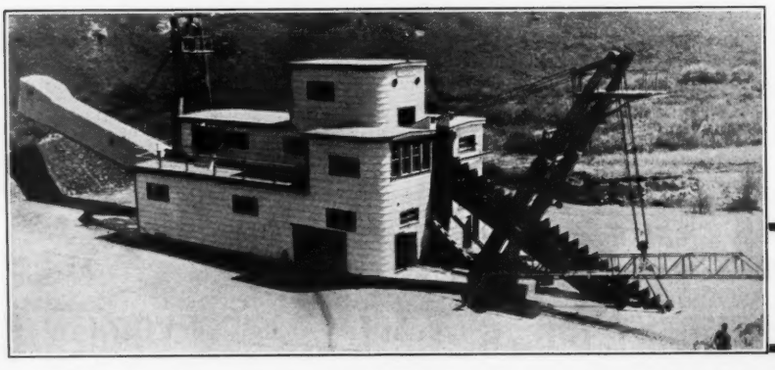

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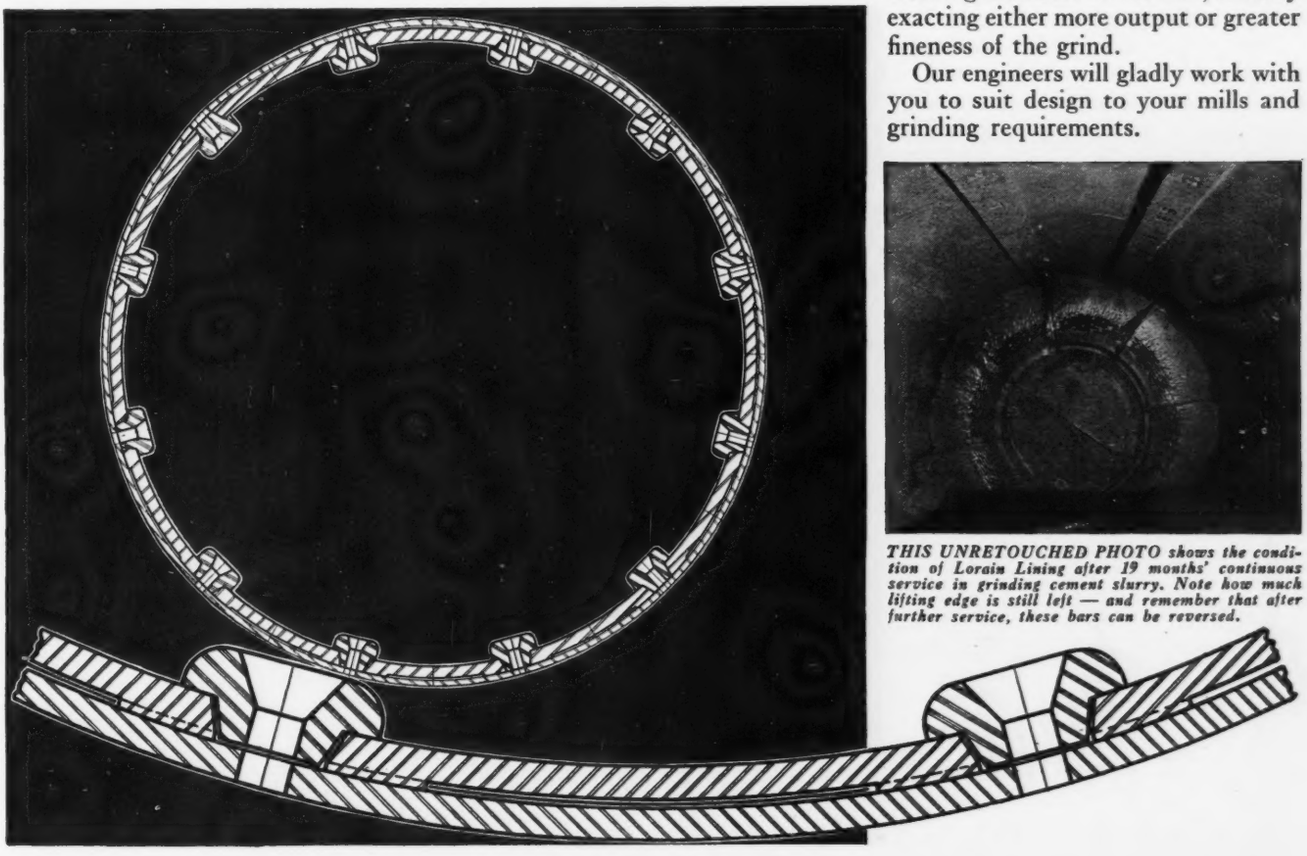

THIS UNRETOUCHED PHOTO shows the condition of Lorain Lining after 19 months' continuous service in grinding cement slurry. Note how much lifting edge is still left — and remember that after further service, these bars can be reversed.

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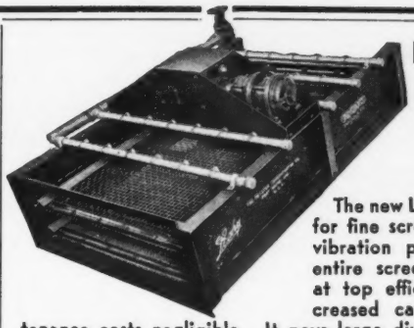

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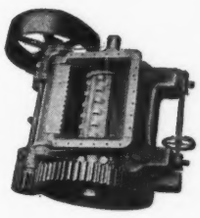

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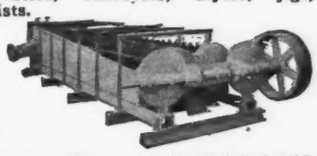

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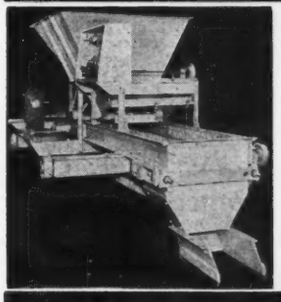

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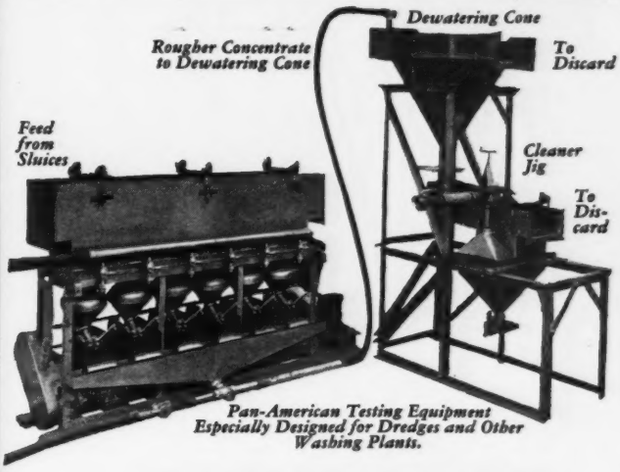

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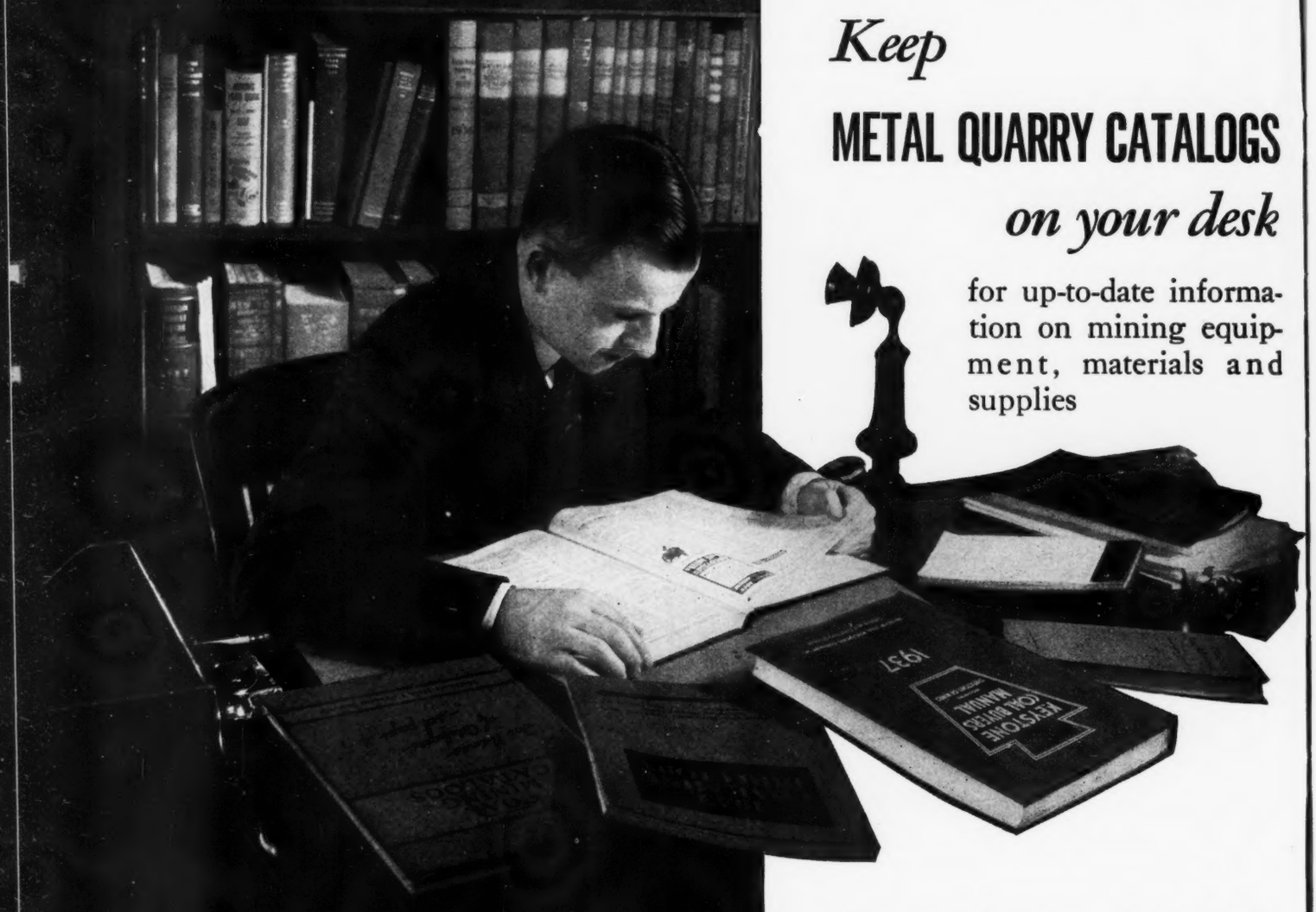

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These are the Link-Belt Positive Self-Aligning Idlers, spaced at suitable intervals, that automatically maintain the conveyor belt in a central carrying position without injury to its edges.

The many Anti-Friction Idlers used on the conveyors illustrated are Link-Belt Type 40. Type 41 return-run idlers are employed. There were 20 conveyors on the order, all Link-Belt equipped.

● Good idlers are of vital importance to satisfactory belt conveyor operation. They preserve the belt, reduce power requirements and maintenance expense, and give long trouble-free service. Link-Belt Anti-Friction Idlers are the product of years of specialization in this field. Among the more recent developments is the Link-Belt Positive Self-Aligning Idler for automatically maintaining the proper position of belt. Submit your conveyor problems to Link-Belt, and let us furnish you the style and type of equipment that will bring you the best results. Catalog sent on request.

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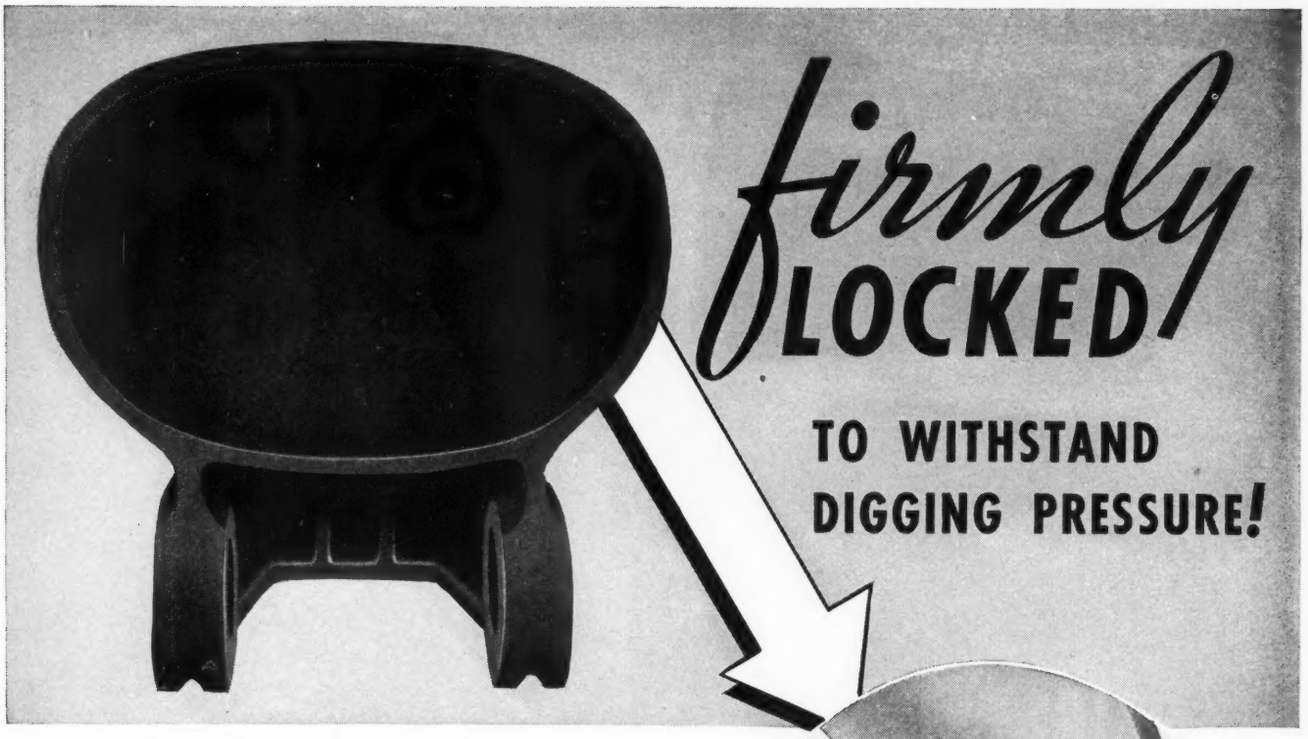

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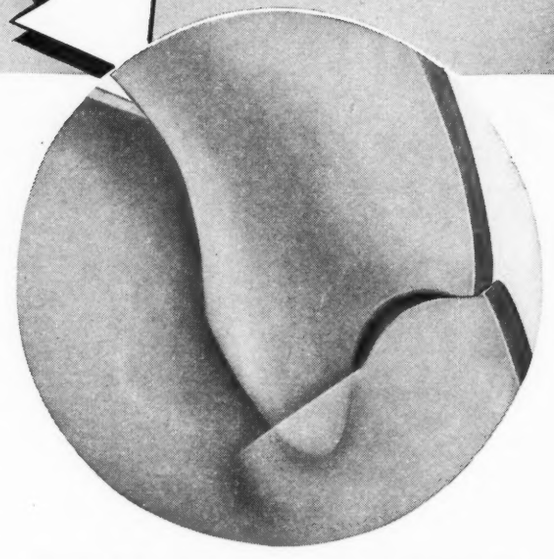
CAN'T LOOSEN . . . CAN'T UNSEAT . . .

they're firmly locked in recessed pockets

The soundness of the *original* rivetless bucket design is well illustrated by its provision for securely locking the lip ends. This is a feature *exclusive* with TISCO Buckets. The TISCO design also permits the use of *lighter weight lips* without any sacrifice in strength . . . which means less metal to buy, and less metal to scrap. » » » Dredge operators give full consideration to the above features when writing bucket specifications. They consider, too, the service record of the bucket, and the steel from which it is made. That's why the TISCO Rivetless Bucket is almost universally employed. For the specification which reads "TISCO Rivetless" calls for a bucket *soundly* engineered, made of *sound* Manganese steel, and backed by a five year record of *sound* performance throughout all placer fields of the world.

*TISCO Rivetless Buckets and Lips are patented in U.S.A. and foreign countries.



Down into that recessed pocket goes the end of the TISCO lip . . . locking it securely in place, free from any movement, during the long life of the lip.

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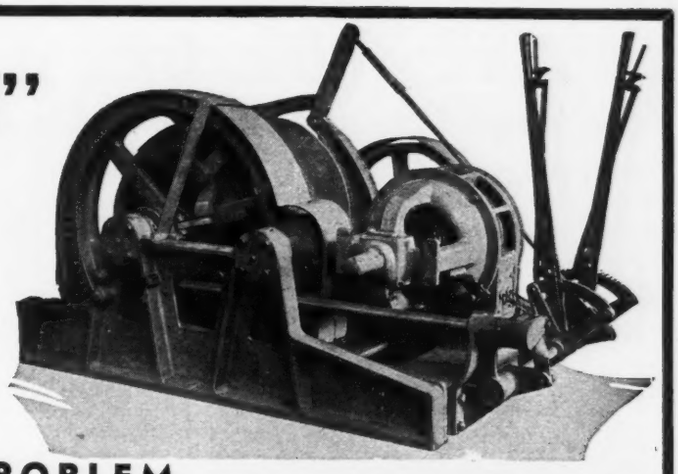

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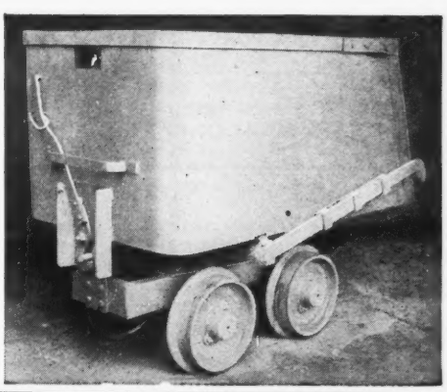

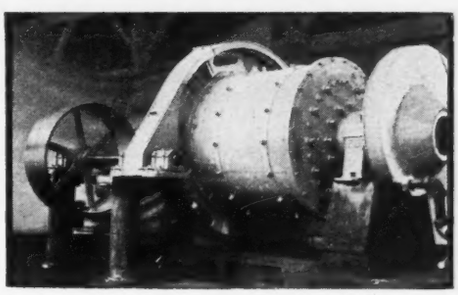

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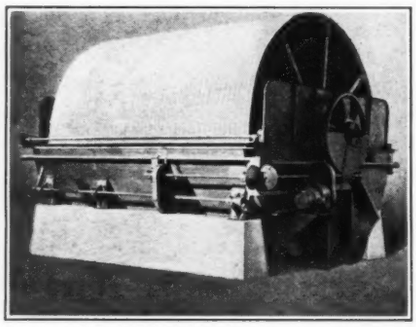

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8—30x10′ 3″ Tanks, 4″ Simplex Pumps
3—30x8′ 3″ Tanks, 4″ Simplex Pumps
5—26x8′ 3″ Tanks, 3″ Simplex Pumps
4—24x8′ 3″ Tanks, 3″ Simplex Pumps
7—22x8′ 3″ Tanks, 3″ Simplex Pumps
6—20x8′ 3″ Tanks, 3″ Simplex Pumps
4—18x6′ 3″ Tanks, 3″ Simplex Pumps
3—16x6′ 3″ Tanks, 2″ Simplex Pumps
6—14x6′ 3″ Tanks, 2″ Simplex Pumps
3—12x6′ 3″ Tanks, 2″ Simplex Pumps

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3—34x30′ Extra Heavy, Hollow Shaft
6—30x24′ Extra Heavy, Hollow Shaft
3—28x20′ Standard, Hollow Shaft
5—26x20′ Standard, Hollow Shaft
3—24x20′ Standard, Hollow Shaft
6—20x20′ Standard, Hollow Shaft
4—18x18′ Standard, Hollow Shaft
3—16x16′ Standard, Hollow Shaft
4—12x12′ Standard, Hollow Shaft

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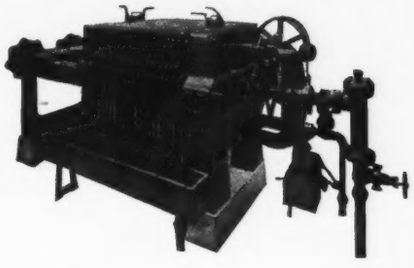

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2—5′x4′ Standard—Spur Gears
1—4′x4′ Dewco—Spur Gears
2—4′x3′ Dewco—Spur Gears

CRUSHERS
JAW TYPE

2—4″x10″ Farrell, Blake
3—7″x10″ Allis-Chalmers, Blake
2—9″x15″ Farrell, Blake
3—9″x15″ Allis-Chalmers, Blake
4—10″x16″ Colorado Iron Works, Blake
2—10″x20″ Farrell, Blake
1—12″x24″ Allis-Chalmers, Blake
3—15″x24″ Farrell, Blake
2—5″x7″ Stearns-Rogers, Dodge
2—7″x11″ Allis-Chalmers, Dodge
2—8″x12″ McFarlane, Dodge
4—11″x15″ Colorado Iron Works, Dodge
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2—9″x16″ Universal
1—14″x36″ Cedar Rapids

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1—No. 7½ McCully
1—No. 6 Allis-Chalmers
2—No. 5 Allis-Chalmers
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4—26′x8′ Thickeners
1—12′x12′ Drum Filter
1—250 Ton Bag Type Precipitation and Clarification Unit
10—Redwood tanks
4—Solution pumps
2—Sand pumps
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10—Redwood tanks

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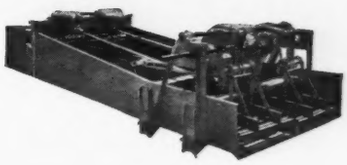

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4—15-in.x12-ft. Standard
2—20-in.x14-ft. 8-in. Standard
6—27-in.x14-ft. 8-in. Extra Heavy
4—27-in.x16-ft. 4-in. Extra Heavy
2—36-in.x16-ft. 4-in. Extra Heavy

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1—27-in.x12-ft. with 6-ft Bowl
1—27-in.x18-ft. with 8-ft. Bowl
1—36-in.x16-ft. with 8-ft. Bowl

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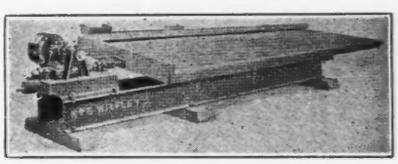
4—No. 3, Vezin Double Arm
1—No. 4, Vezin Double Arm
2—18-in. Allis-Chalmers Disc Type
2—Galigher Wet Pulp Samplers
1—Flood Wet Pulp Sampler
4—Thruster Type Wet Pulp Samplers



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All Types Equipment—Bought and For Sale

25 to 1150 HP Diesel Engines, also Gen. Sets.
200 and 300 KW, 440-2300 v. Skinner Uniflows.
500 to 15000 KW Steam Turbine Generator Sets.
10x16" to 60x84" Jaw Crushers & Pulverizers.
3 ft. Telsmith Gyrasphere Cone Crusher. No. 36.
No. 2 to No. 18 Gyratorys, Primary & Reduction.
120 ton Railroad Track Scale. 50' Platform.

MISSISSIPPI VALLEY EQUIPMENT CO.
507-M Locust St. St. Louis, Mo.

3—**Battery Type Locos.** 4 ton, 24" ga.
12—**Dump Cars** 1½ yd. 24" ga.
3—50 HP **Electric Shaft Hoists**
1—**Byers Rock Shovel** ⅜ yd.
Ing-Rand Sinking Pumps
Ing-Rand Pumps models GSS and CRVH
1 yd. and ¾ yd. **Owens & Williams Clamshell Buckets**
Barnes self-pr. Cent. Pumps 3", 4", 6" gas and elec.
100 tons **35 lb. Rail**
1—**Connersville Blower**
3 yd. **Dragline Scraper Hoist**
Merrick Weightometer Scale for 24" belt

J. T. WALSH
500 Brisbane Bldg. Buffalo, N. Y.

SURPLUS RUBBER CONVEYOR BELTING

1,000 Ft. 60 In. 10 ply heavy duty
600 Ft. 40 In. 7 ply. ⅛ top
600 Ft. 36 In. & 600 ft. 30 in. 6 ply
1,000 Ft. 24 In. 5 ply ⅛ top
900 Ft. 20 In. 5 ply ⅛ top
642 Ft. 18 In. 4 ply 3/32 top
500 Ft. 16 In. 4 ply 3/32 top
600 Ft. 14 In. 4 ply 1/16 top

SAMPLES FURNISHED ON REQUEST

AIR COMPRESSORS

360', 528', 860' & 1300' Ingersoll-Rand Bltd.
354 ft., 603 ft. & 1000 ft. Ingersoll-Rand Diesels.
3—752 ft. Sullivan 16x9¾x10-WJ3. Belted.
676—1302—1503—2200—3600 ft. Elec. Drive.

MACHINERY

5—Tyler Hummer Vibrating Screens.
Jaw Crushers: 36x10, 36x6, 30x13, 7½x13, 24x36, 42x48, 60x84, 36x18, 11x16, 12x18, 18x11, 20x10, 42x18, 20x10, 16x9 & 30x15.
Ball Mills: 3'x36", 7'x22", 8'x22" & 8'x10'.
Elec. Mine Hoists—30, 60, 110, 140 & 400 H.P.

R. C. STANHOPE, INC.
875 6th Ave., New York City

1000 KW 250 volt 3 wire Westinghouse **TURBO GENERATOR** Set, straight condensing, or extraction type. With Surface Condenser.
(2) 404 HP Springfield Cross Drum W.T. **BOILERS**, 200# A.S.M.E. Code.

Power Plant Equipment Co., Inc.
41 Cortlandt St., New York, New York

MACHINE TOOLS

Lathes, Shapers, Automatics, Drills, Planers, Milling Machinery, Boring Mills, Grinders, etc.

Large buyers of surplus machine tools and sellers of guaranteed rebuilt metal working machinery—Reliable, dependable.

SUN MACHINERY COMPANY
36 Van Vechten St., Newark, N. J.

ROTARY FILTERS

2—Portland 12'x12' Rotary Vacuum Filters, complete with Oliver 14"x8" Dry Vacuum Pumps and Receivers.

STEIN EQUIPMENT CORPORATION
426 Broome Street New York City

NEW AND USED

TUBING — CASING — PIPE

Large stocks carried everywhere

JOS. GREENSPON'S SON PIPE CORP.
Natl. Stock Yds. (St. Clair Co.), Ill.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

10 cents a word, minimum charge $2.00.

Positions Wanted (full or part-time salaried employment only) ½ the above rates, payable in advance.

(See ¶ on Box Numbers)

Proposals, 40 cents a line an insertion.

INFORMATION

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads. Replies forwarded without extra charge.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

Continued from pages 95, 96 and 97

DISPLAYED—RATE PER INCH:

1 inch $6.00
2 and 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. *Contract rates on request.*

EMJ

1—**American, Double Drum, Hoist**, 52 hp. 440 v.
1—**American, Dble Drum**, Duplex, 80 hp. 440 v.
5—**Willamette, Double Drum**, Duplex, 2—75 hp. 550 v. motors.
1—**Willamette 2-drm Yard, Hoist**, 75 hp. 550 v.
4—**Willamette Yarding Hoists**, 3-drum, 2-speed, 200 hp. 550 v. 585 R.P.M. motors
6—**Willamette Yarding Hoists**, 3-drum, 2-speed, 300 hp. 550 v. 585 R.P.M. motors
1—**Willamette Incline Hoist**, 750 hp. 2200 volt, mounted, 70-ton steel car, std. ga.
17—**500 kva G.E.** 22000/600 v. 3 ph. **transformers**
3—6-ton **Bald.-West.** 30" ga. **Bat. Locomotives**
1—5-ton **G.E.** 30" ga. **Battery Locomotive**
1—4-ton **Jeffrey**, 30" ga. **Bat. Locomotive**
4—Type **E. G. Elwell Parker Elevating Trucks**
900—30" ga. 20# **Rail Wier Switches**
1—#11 **Sturtevant Pressure Blower**
1—One-yard **Osgood Gas Shovel**
1—20-ton **Ohio Locomotive Crane**, Std. ga.
1—60-ton **Lima Shay Locomotive**, Superheater

PENSACOLA COMPANY

Pinedale, Fresno Co., Calif. — **1100 Fourth St., Berkeley, Calif.**

DRIFTER BARGAINS

52—**Chicago Pneumatic** CP-5 Drifters.
36—**Gilman** R-221 Drifters.
26—**CP**-10 Sinkers with Drifter Attachments.
6—**Ingersoll-Rand** S-70 Drifters.

Also large stock of repair parts for all of the above.

Priced to sell.

R. H. BOYER

302 Harrison Bldg. — **Phila., Pa.**

LOW BARGAIN PRICES

RUBBER BELTING
Transmission • Conveyor • Elevator

"V" BELTS
for
Pumps • Crushers • Pulverizers, etc.

RUBBER HOSE
for
AIR • WATER • STEAM, ETC.

CARLYLE RUBBER CO., Inc.

64 Park Place — **New York, N. Y.**

New "SEARCHLIGHT" Advertisements

must be received by the 2nd of the month to appear in the issue out the same month.

Address copy to the Departmental Advertising Staff

Engineering and Mining Journal
330 West 42nd St., New York City

THE TONOPAH MINING CO. OF NEVADA
EXPLORATION DEPARTMENT
Prospects of Merit Financed
Write Either

H. A. JOHNSON, Supt. of Operations, Tonopah, Nevada — **Or Main Office 570 Bullitt Bldg. Philadelphia, Pa.**

POSITIONS VACANT

WANTED, BOLIVIA. Mill shift bosses, age 30 to 45, with flotation and gravity concentration experience. Must speak Spanish. Salary £40.—monthly. Three year contract. Altitude 13,000 feet. Send references and photograph with application. Only experienced men wanted; no other need apply. P-823, Engineering and Mining Journal, 330 West 42nd Street, New York City.

EXPERIENCED VENTILATION ENGINEER at large western metal mine. Starting salary $200 monthly. P-852, Engineering and Mining Journal, 330 W. 42nd St., New York, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS. $2,500 to $25,000. This thoroughly organized advertising service of 29 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo, N. Y.

POSITIONS WANTED

GRADUATE GEOLOGIST & ENGINEER, 32, married, 6 years experience mining in U. S. and 2 years general superintendent in Philippines. Experienced in placer and lode operations also prospecting and geophysics. Foreign country preferred. PW-838, Engineering & Mining Journal, 883 Mission St., San Francisco, Calif.

MINING ENGINEER, age 34, good health, married, no children, speaks Spanish, eleven years experience, desires position as mine superintendent or mine foreman. Will go any place. PW-829, Engineering & Mining Journal, 520 North Michigan Ave., Chicago, Ill.

MINING ENGINEER, age 36, technical graduate, extensive experience. Desire connection responsible company or individual. PW-846, Engineering and Mining Journal, 330 W. 42nd St., New York, N. Y.

MINING GEOLOGIST-ENGINEER. Technical graduate. Twelve years experience mining, geology, metallurgy. Desires position assistant to consulting mining geologist. Salary not main interest. PW-842, Engineering and Mining Journal, 520 N. Michigan Ave., Chicago, Ill.

MINE OFFICE. Am well qualified to assume full responsibility for accounting, purchasing and materials supply for mine and mill. Broad experience makes me a valuable assistant to Supt. by competently handling many details of the operation. Age 36. Available on month's notice. PW-844, Engineering and Mining Journal, 883 Mission St., San Francisco, Cal.

MILL FOREMAN. Practical and economical operation and maintenance all type concentrators domestic and foreign experience. 25 years actual experience and charge of all departments of concentrator. Take full responsibility and can handle men. Speak Spanish. Married. Desires permanent position. Foreign preferred. At present employed. Available on short notice. Furnish best of references. PW-849, Engineering and Mining Journal, 883 Mission St., San Francisco, Cal.

MASTER MECHANIC. Good health, married, sober and industrious. Expert gas and electric welder. Served apprenticeship as machinist. Know machine tools and shop practices. Know steam, gas, electric or diesel. Will go anywhere. At present employed on large construction job as Welding Foreman. PW-850, Engineering and Mining Journal, 520 N. Michigan Ave., Chicago, Ill.

BUSINESS OPPORTUNITIES

For the information of Readers:
Organizing and incorporating costs incurred in connection with capital raising are usually quoted as a separate cost not conditioned upon or related to the actual raising of capital or any fees earned thereby.

Corporate Financing

Inquiries solicited from corporations requiring capital for expansion or other corporate purposes. Brown Hartwell Company, 110 East 42nd Street, New York, N. Y.

Gold Placer

1140 acres Government Engineers Reports available. Want cash offer, must sell. Write P.O. Box 1022, Reidsville, North Carolina.

Partner Wanted

For newly completed smelter. Must be competent smelter man. For particulars write I. Blum, Mojhave, California.

SELLING OPPORTUNITIES
OFFERED—WANTED
Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITY WANTED

SALES ENGINEER. Long and successful experience in the U. S. A. and South America. Capable of handling sales and distribution of ore reduction and milling equipment. Available now. Will go anywhere. SA-851 Engineering & Mining Journal, 520 N. Michigan Ave., Chicago, Ill.

WANTED

WE BUY mineral specimens suitable for collectors, museums and study purposes, in lots of from ten to one hundred pounds. Write first. American Mineral Exchange, 212 Pacific Ave., Houston, Texas.

SOUTHERN MINERAL DEPOSITS

An experienced Mining Engineer, centrally located, and possessing an intimate knowledge of many deposits of commercial minerals, such as Manganese, Chromium, Zinc, Gold, etc., located in the Southern Appalachian Provinces. Wishes a connection with a responsible party, who would be interested in their exploration, and development or exploitation. Either a "Grub Stake," or fixed compensation arrangement will be entertained. References. Address—
Mining Engineer, Box 1012, Hendersonville, N. C.

PRECIOUS METAL MINE

Experienced operators want outstanding lode property that will develop large reserves and large scale operation. Net smelter values must total at least ten dollars and show profit commensurate with investment and risk involved. We neither buy nor sell stock. Submitting mere possibilities will waste your time. No offering considered unless complete detail accompanies first letter.

240 No. Cliffwood Ave., Los Angeles, Cal.

DIVIDEND NOTICE

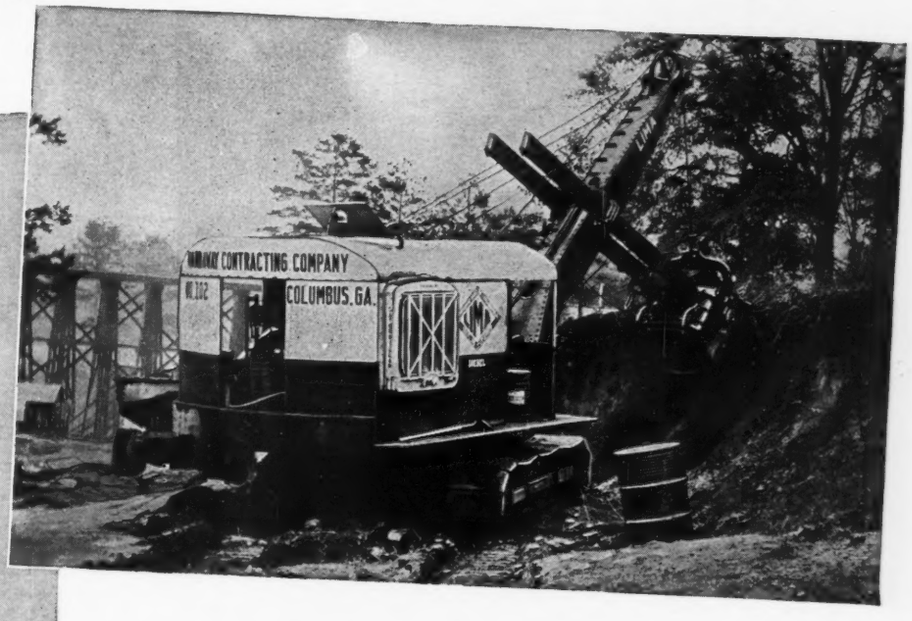
ANACONDA COPPER MINING CO.
25 Broadway
New York, N. Y., November 23, 1938.
DIVIDEND NO. 122.

The Board of Directors of the Anaconda Copper Mining Company has declared a dividend of Twenty-five Cents (25c) per share upon its Capital Stock of the par value of $50, per share, payable December 22, 1938, to holders of such shares of record at the close of business at 3 o'clock P.M., on December 6, 1938.

D. B. HENNESSY, Secretary.

Southern Contractor

Lengthens Shovel Life



PERFECTLY LUBRICATED

This Lima Diesel-powered Shovel of the Hardaway Contracting Co. is lubricated with Texaco 100%, as follows:

- **Texaco Ursa in the Caterpillar Engine**
- **Texaco Marfak in the shackles, universals, large anti-friction bearings**
- **Texaco Thuban in gear case**
- **Texaco Cup Greases**
- **Texaco Crater Compound on all wire rope, gear teeth, chain**

Free Booklet. *32 pages of money-saving information on the lubrication of gears and wire rope.*

THE PHOTOGRAPH PICTURES LIMA No. 102 . . . one of the shovels belonging to the Hardaway Contracting Co., Columbus, Georgia. Hardaway keeps its equipment on the various jobs through regular use of Texaco Lubricants.

On the wire rope, chains, gears, and crawler mechanism, Hardaway uses Texaco Crater Compound.

Texaco Crater adheres to the wearing surfaces of metal, despite heat, cold, rain, submergence in water. Where other greases drip and wash away, Crater clings.

If you want *your* equipment to last longer, get in touch with Texaco. Trained lubrication engineers are at your service, and 2186 warehouses assure prompt delivery. Write or phone the nearest one, or direct your inquiry to:

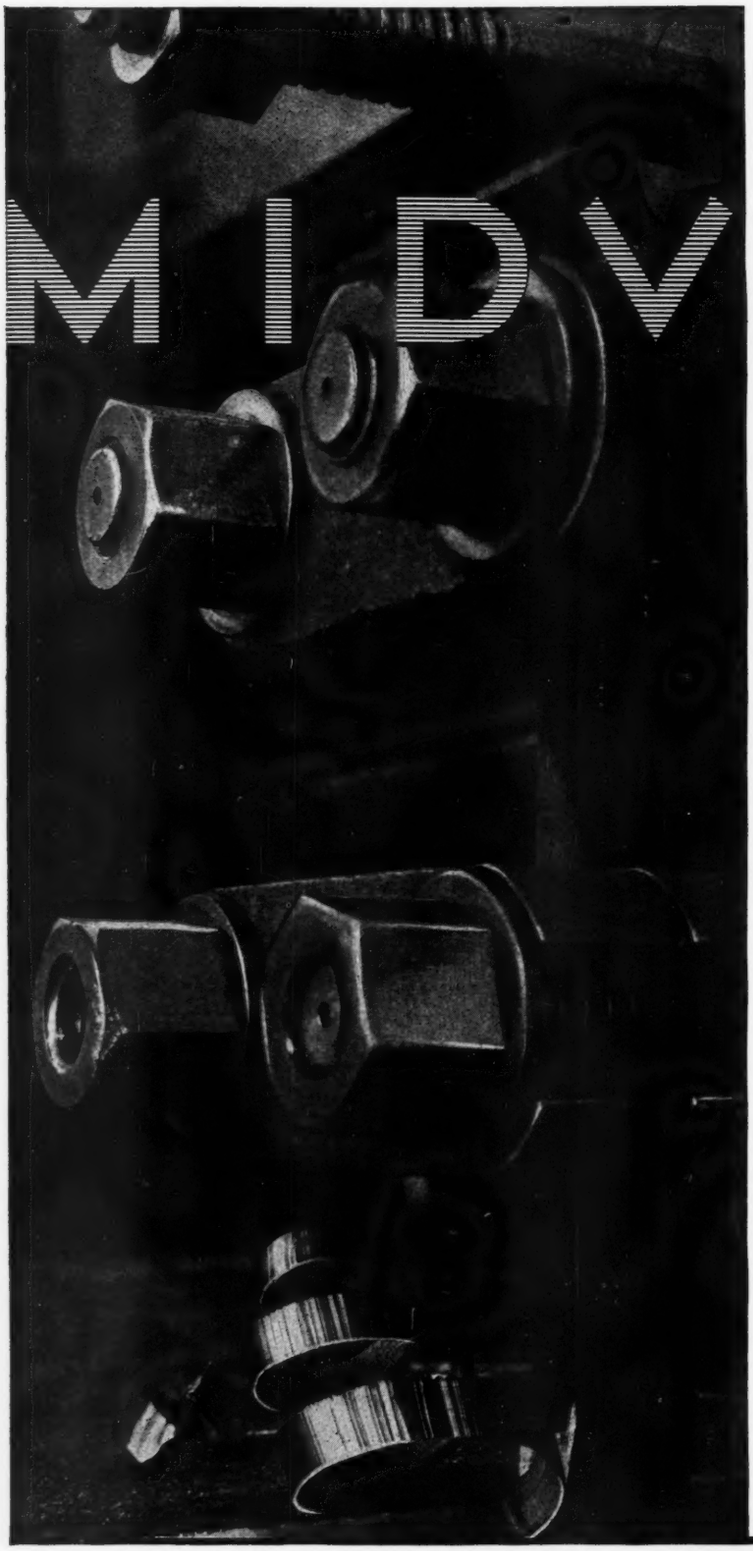
The Texas Company, 135 East 42nd Street, N. Y. C.

TEXACO
REG. T. M.

Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night—Columbia Network—9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 6:00 P.S.T

TEXACO *Crater Compound*

FOR GEARS, CHAINS, WIRE ROPE



MIDVALE

Tool Steel

. . . handles heavy hogging, or finest machining

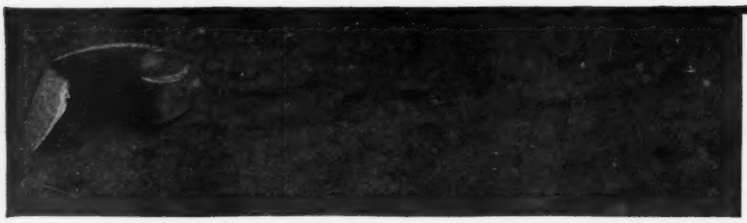
Mammoth pressure vessels, or machining of micrometer precision . . . both types of work go through the Midvale plant. And on all types of steel, including many alloys.

Tools must stand up—in the Midvale shops—in your shops.

Midvale tool steels are continuously subjected to the acid test of actual production . . . an extra insurance that they will properly serve you in your most exacting work.

THE MIDVALE COMPANY • NICETOWN • PHILADELPHIA

OFFICES: *New York • Chicago • Pittsburgh • Washington • Cleveland • San Francisco*



REPLACES 2 OILS AND SAVES BEARINGS

ON SHOVEL MOTOR-GENERATOR SET...

• ORDINARILY, shovel operation in stripping required two oils, one for summer and one for winter lubrication of motors and motor generator bearings. A central state operator was having trouble during the spring and fall seasons, when temperatures varied widely, in determining just when to change oil. Each change of season brought a disheartening number of bearing failures.

The Standard Lubrication Engineer told him about Stanoil No. 25, an oil with low pour test that maintains its lubricating quality over a wide range of temperatures.

With Stanoil No. 25 in the bearings the year around, the chief electrician found that he could quit trying to outguess the weather man. Bearing failures stopped, and, in addition, he had one oil less to stock. The slightly higher cost of the oil was more than paid for by saving in bearings and repair costs.

It's almost certain that somewhere in your operation the higher quality in Stanoil will pay its way in reduced maintenance and lower ultimate oil costs. Let a Standard Lubrication Engineer point out some of these places. He'll make this analysis at no cost to you. Call him at the nearest Standard Oil (Indiana) office or write 910 South Michigan Avenue, Chicago, Illinois.

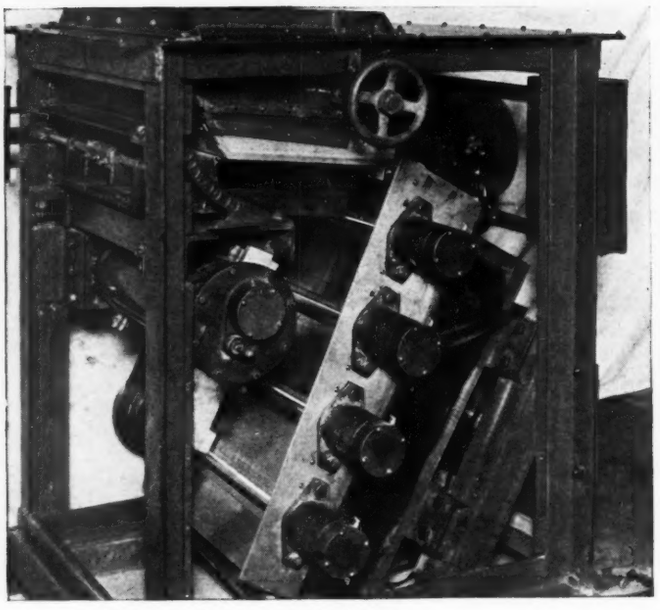
Copr. 1938, Standard Oil Co.

STANOIL

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING THE RIGHT LUBRICANT • PROPERLY APPLIED

YOU CAN BANK ON ITS PERFORMANCE



BUILT BY DINGS MAGNETIC SEPARATOR CO.

It's perfectly obvious why Dings selected 10 SKF Bearings for vital rotating parts of this Magnetic Separator. They wanted a self-aligning bearing that could be depended upon for good performance at all times.

SKF Bearings keep shafts which close the gap between the magnetic fields always in correct position. Totally enclosed, they are not affected by abrasive grit or moisture. They require no adjustments, and their self-alignment compensates for slight initial misalignments without binding or cramping the bearing.

This is another example of the benefits derived through SKF's mastery of bearing problems. These advantages are *yours* when you specify SKF. 4223

SKF INDUSTRIES, INC., PHILADELPHIA, PA.

THE BEARINGS ARE SKF

BALL & ROLLER BEARINGS

TIGHT *LEAK-PROOF* VALVES are the *SAFEST* INSURANCE

Point by point, Nordstrom Valves meet every major valve need

POINT 1—QUARTER TURN
Quickest to open or close.

POINT 2—SIMPLEST DESIGN
Fewest parts. Nothing to clog.

POINT 3—"SEALDPORT" LUBRICATION
Patented feature provides proper lifting of plug byy positive pressure.

POINT 4—FULL-FLOATING PLUG
Always easy to turn. Non-freezing.

POINT 5—POSITIVE PLUG SEAT
Plug rides on pressure lubricant seat from which it is never separated.

POINT 6—NON-STICKING
Powerful hydraulic force performs triple function—lifts plug to turn easily; lubricates and seals valve.

POINT 7—STREAMLINED FLOW
Minimum resistance to line flow.

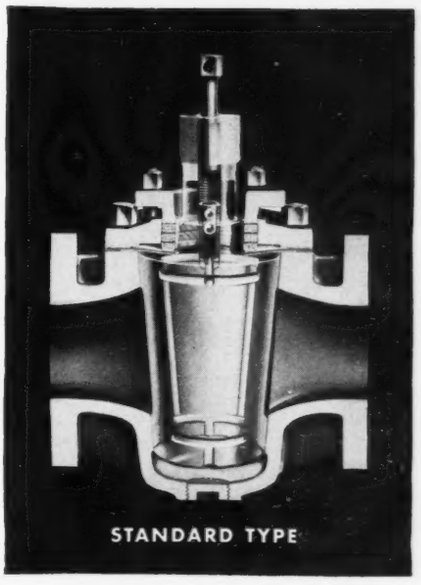
POINT 8—NON-LEAKING
Sealed by lubricant under pressure: prevents external and internal leaks.

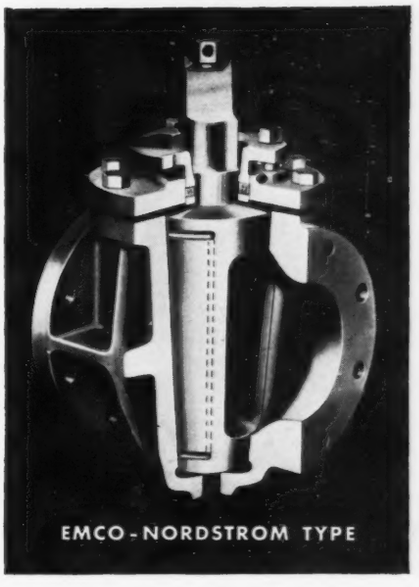
POINT 9—UNEXPOSED LUBRICANT
"Sealdport" lubricant grooves in plug and body so arranged that line contents cannot blow through when lubricant screw is removed.

POINT 10—CHECK VALVES
One or more ball checks in shank.

POINT 11—SPECIAL LUBRICANTS
Highly developed lubricant and plastic materials in every consistency to meet specific needs for all variations of temperature and line contents.

POINT 12—SPECIAL ALLOYS
For every service, including iron, Nordco steel, semi-steel, stainless steel, bronze, Mercoloy, aluminum, nickel alloys, etc.


STANDARD TYPE


EMCO-NORDSTROM TYPE

Nordstrom Air Cocks especially desirable for mining service

Developed particularly for services such as underground air service outlets and similar requirements in which a positive, smooth-acting and durable throttling or cut-off valve is required. Lubricated. Sizes, ½", ¾" and 1".

Ask for Bulletins

Merco Nordstrom Valve Co.
A Subsidiary of
Pittsburgh Equitable Meter Co.

Main Offices: Pittsburgh, Pa. Branch Offices: New York City, Buffalo, Philadelphia, Columbia, Memphis, Chicago, Kansas City, Des Moines, Tulsa, Houston, Los Angeles, Oakland. Canadian Representatives and Licensees: Peacock Brothers, Ltd., Montreal, Quebec. European Licensees: Audley Engineering Co., Ltd., Newport, Shropshire, England.

No. 1404
Nordstrom Air Cock

NORDSTROM VALVES "Sealdport" Lubrication

REQUEST FOR BULLETINS

MERCO NORDSTROM VALVE CO.
400 Lexington Ave.,
Pittsburgh, Penna.

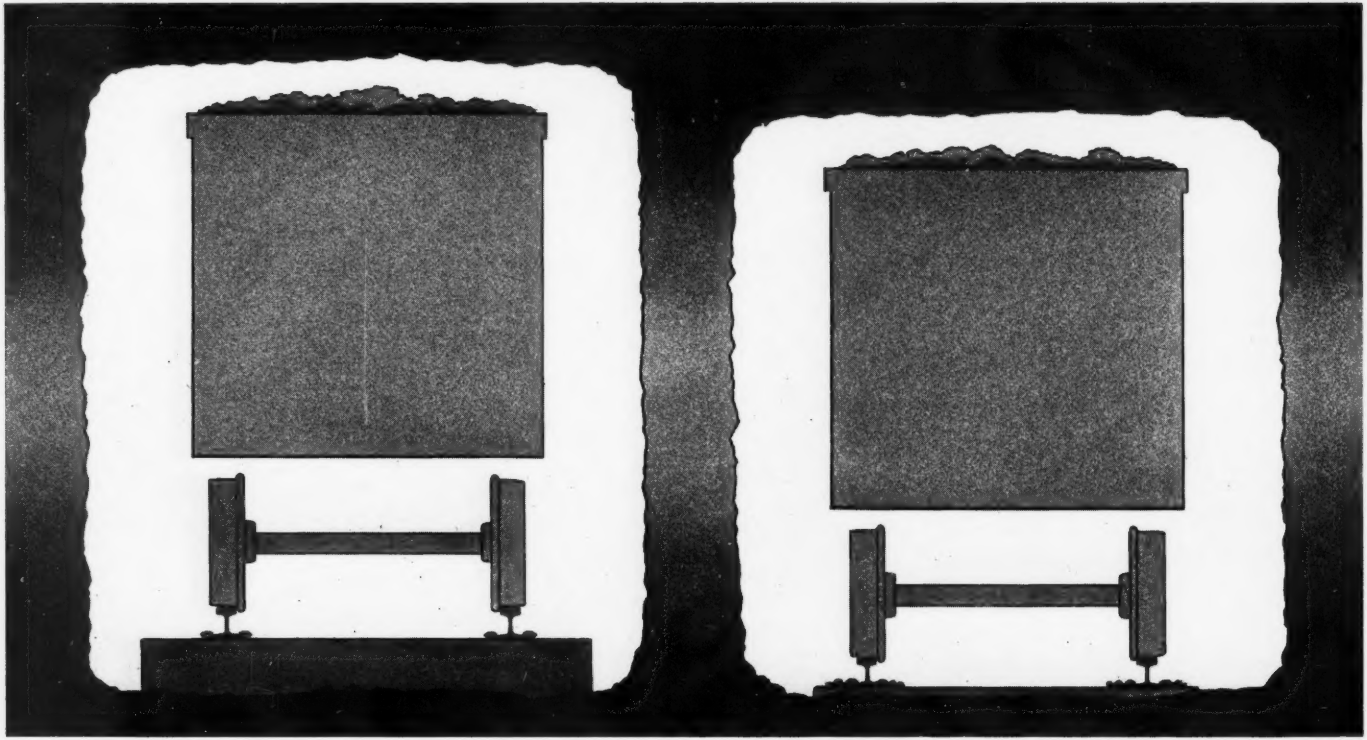
Send Bulletins describing Valves for Mining service

Name .....

Address .....

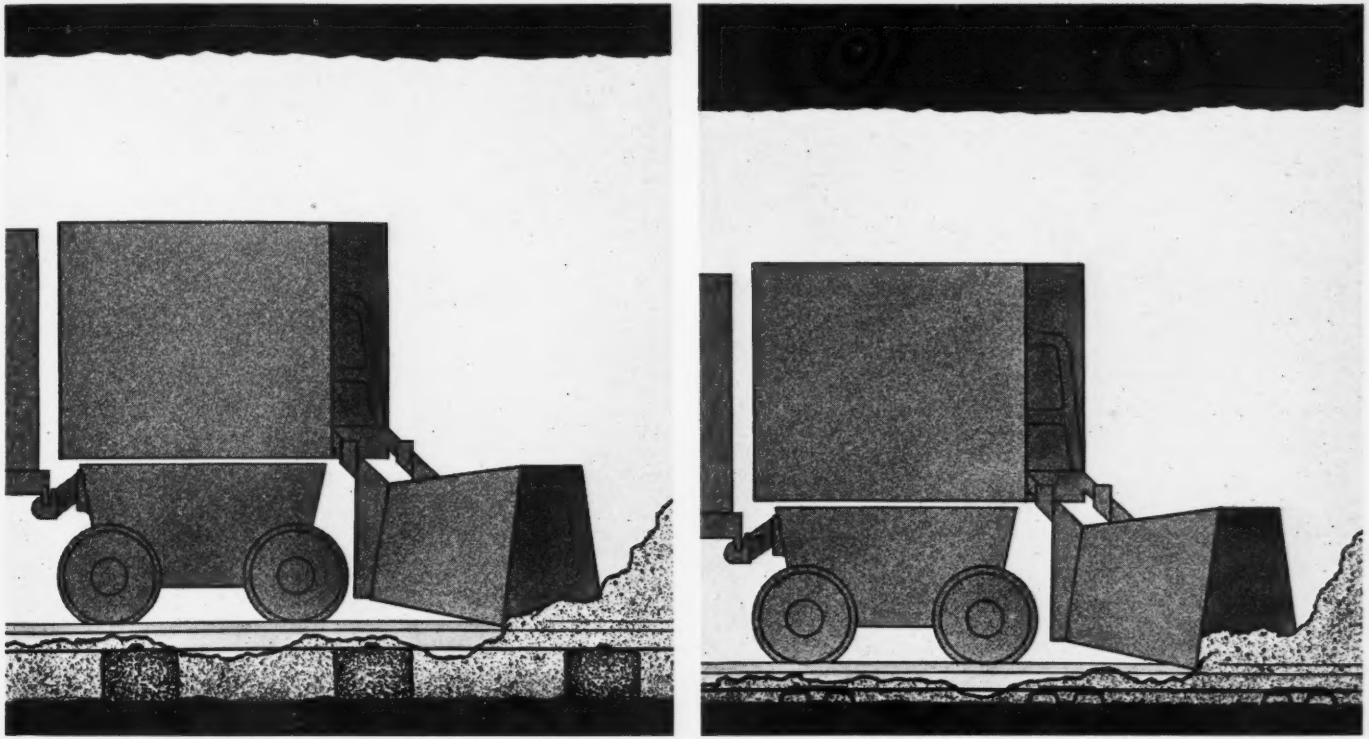
City .....*State*.....

6 REASONS FOR

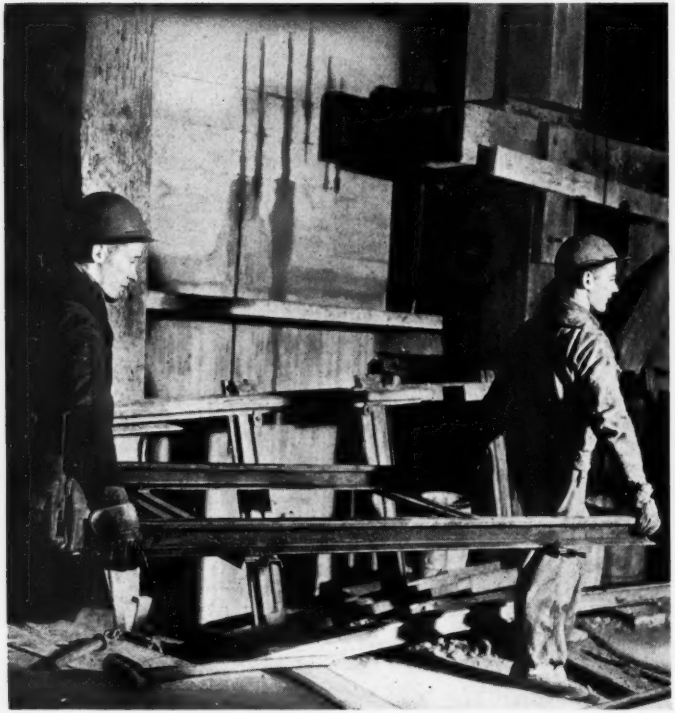


SMALLER TUNNELS—Track laid on steel ties needs less head clearance. Even the heavy No. 3 Bethlehem mine tie keeps the rail within an inch of the floor. Saving in height is several inches; space that means dollars in driving tunnels. No. 2 tie will handle rail up to 30 lbs.; has a rail-bearing height of just 11/16 in.

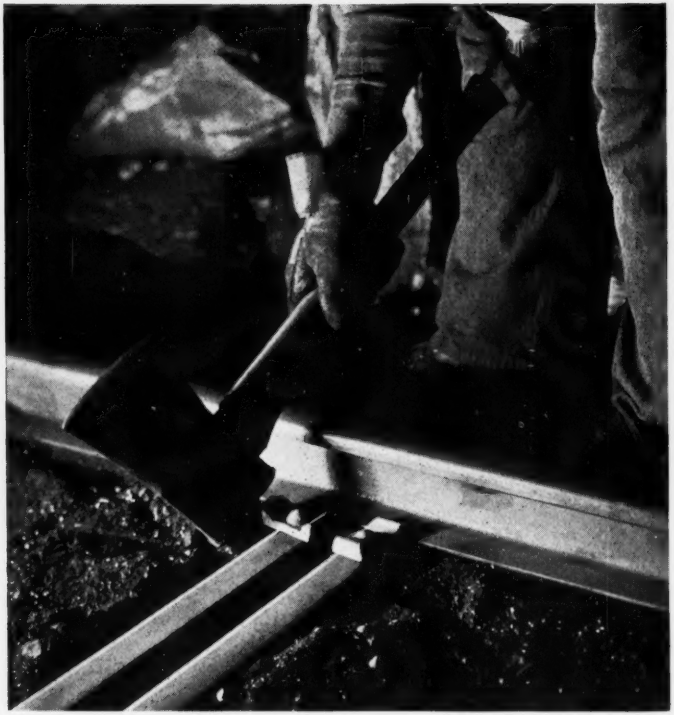
USING STEEL TIES



BETTER MUCKING—Track-mounted mechanical muckers will clean up better when operating from track laid on Bethlehem steel mine ties. Reason: Bethlehem Ties are lower than wood ties. These extra inches mean greater reach, better cleaning of the floor. Too, Bethlehem Ties provide the sturdy foundation required by track for mechanical loaders.

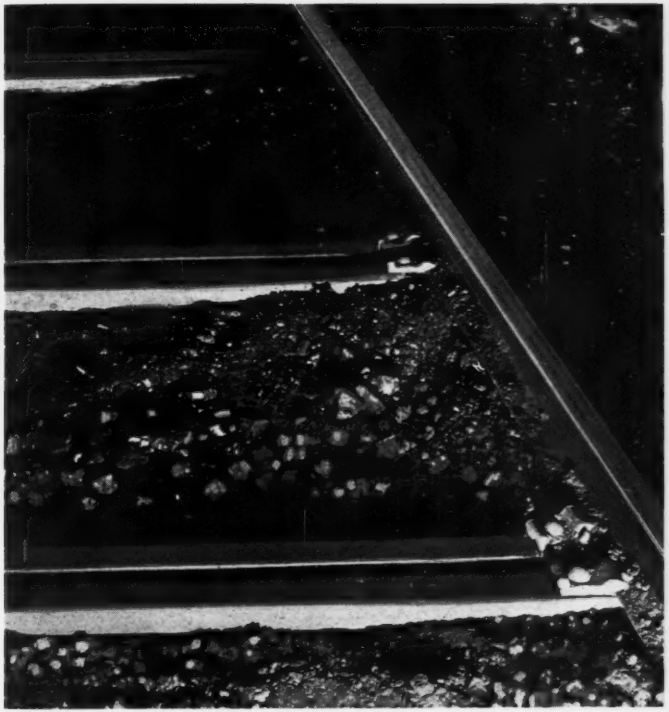


PORTABLE SECTIONS—Portable sections, such as this, speed up tunnel work, particularly when mechanical mucking is used. Built up with Bethlehem steel ties, later replaced with permanent track.



FASTER INSTALLATION—Permanent or temporary track can be laid faster with Bethlehem steel ties. There are no spikes to drive; no gaging to do. Steel clips automatically set gage.

BETTER TRACK—Even when clearance is no object, Bethlehem steel ties used as gage rods along with wood ties will make better track. They keep track true to gage, and prevent rails from turning over under load.

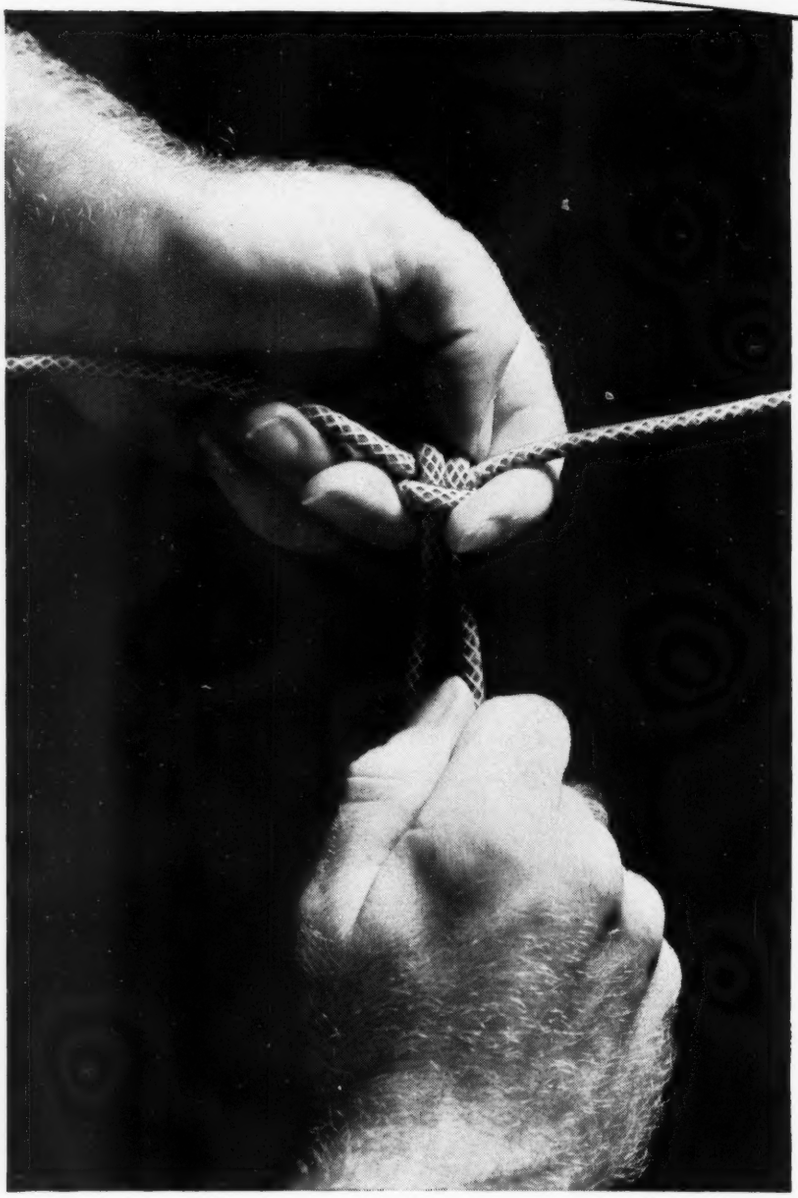


LOWER MAINTENANCE—With no spikes to pull loose, no chance of track getting out of gage, maintenance costs are materially lowered. Fewer derailments, too, mean less repair work.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

Primacord the new Tie-up to Profits



This half hitch is the "switch" that connects each hole with the main line in a Primacord-Bickford hook-up.

Simple, isn't it! No tools are required to make this knot. Yet, made properly and drawn up tight, it switches the detonating wave at 3.85 miles per *second!*

Primacord-Bickford Detonating Fuse consists of a core of PETN in a waterproof textile cover. It offers economies in material, shipping, storing and handling. Plain Primacord weighs about 15 lbs. per 1,000 ft. and its tensile strength is 113 lbs. "Reinforced" and "Wire Bound" Primacord are also available where extra strength and resistance to abrasion are essential.

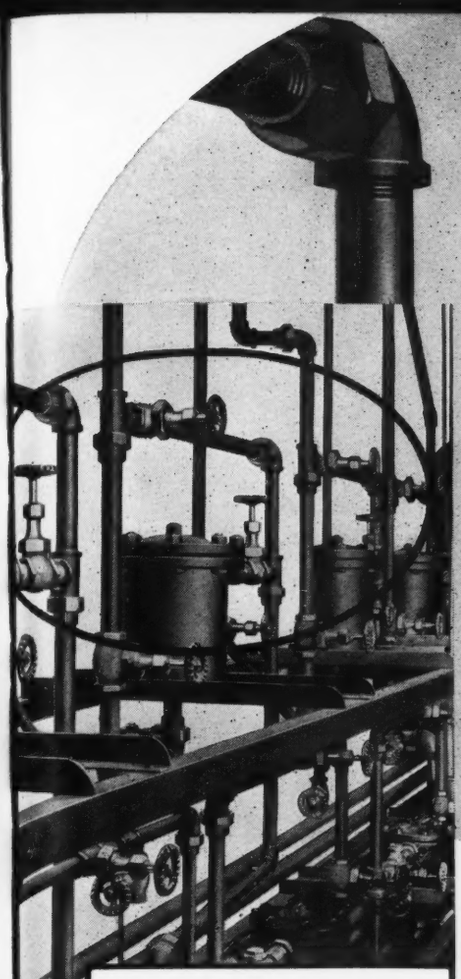
Tie-up to greater profits in blasting with the new, *well tried* detonating fuse. For further information write for the Primacord Booklet.

THE ENSIGN-BICKFORD COMPANY, SIMSBURY, CONN., U.S.A.

Makers of Cordeau-Bickford Detonating Fuse—and Safety Fuse Since 1836

PRIMACORD-BICKFORD *Detonating Fuse*

PB3



This Union Tee replaces regular tee, two unions, two nipples, and reduces pipe joints from seven to three. Each trap is hooked up in same way.

The use of Union Fittings at these points eliminates regular ell and tee, two unions, two nipples, and reduces pipe joints from eight to four.

A comparison of piping materials and pipe joints required to hook up this bank of steam traps—

	—with Union Fittings		—with Regular Fittings	
	Quan.	Pipe Jts.	Quan.	Pipe Jts.
Ells	1	2	13	26
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TOTALS	39	88	93	197

How CRANE UNION FITTINGS SAVE MATERIAL, TIME AND LABOR

The use of union fittings in piping systems is often overlooked. They are valuable even in simple hookups, but in more elaborate layouts, their advantages are emphasized. Because a single union fitting ordinarily serves the same purpose as a tee or elbow, union and nipple, installation costs are minimized—in material, time and labor. Union fittings reduce the number of threaded joints—giving greater safety. Pipe lines gain a workmanlike makeup that adds to plant appearance.

Depend on Crane-Quality union fittings to help keep your liquid, air, and vapor lines at peak efficiency always. The amazing standard of perfection that Crane has attained in the manufacture of millions upon millions of fittings of every type yearly, is strong assurance of their unfailing, trustworthy performance. You'll find that Crane-Equipment throughout your plant brings greatest piping satisfaction, because—in fittings as in valves—

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of Crane fittings are found fit. Details in folder sent upon request.

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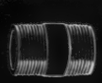
TEES—Service, Four-Way, Drop Tees, Long Sweep, Double Sweep, Wash Tray

COUPLINGS—Right Hand, Right and Left, Half (Also Wrought Iron), Reducers, Increasers

UNION FITTINGS—M... and Female, 90° and ... Elbows, Tees with Union Run or Outlet

BUSHINGS—Outside and Inside Hexagon, Face, Eccentric, Double Tapped

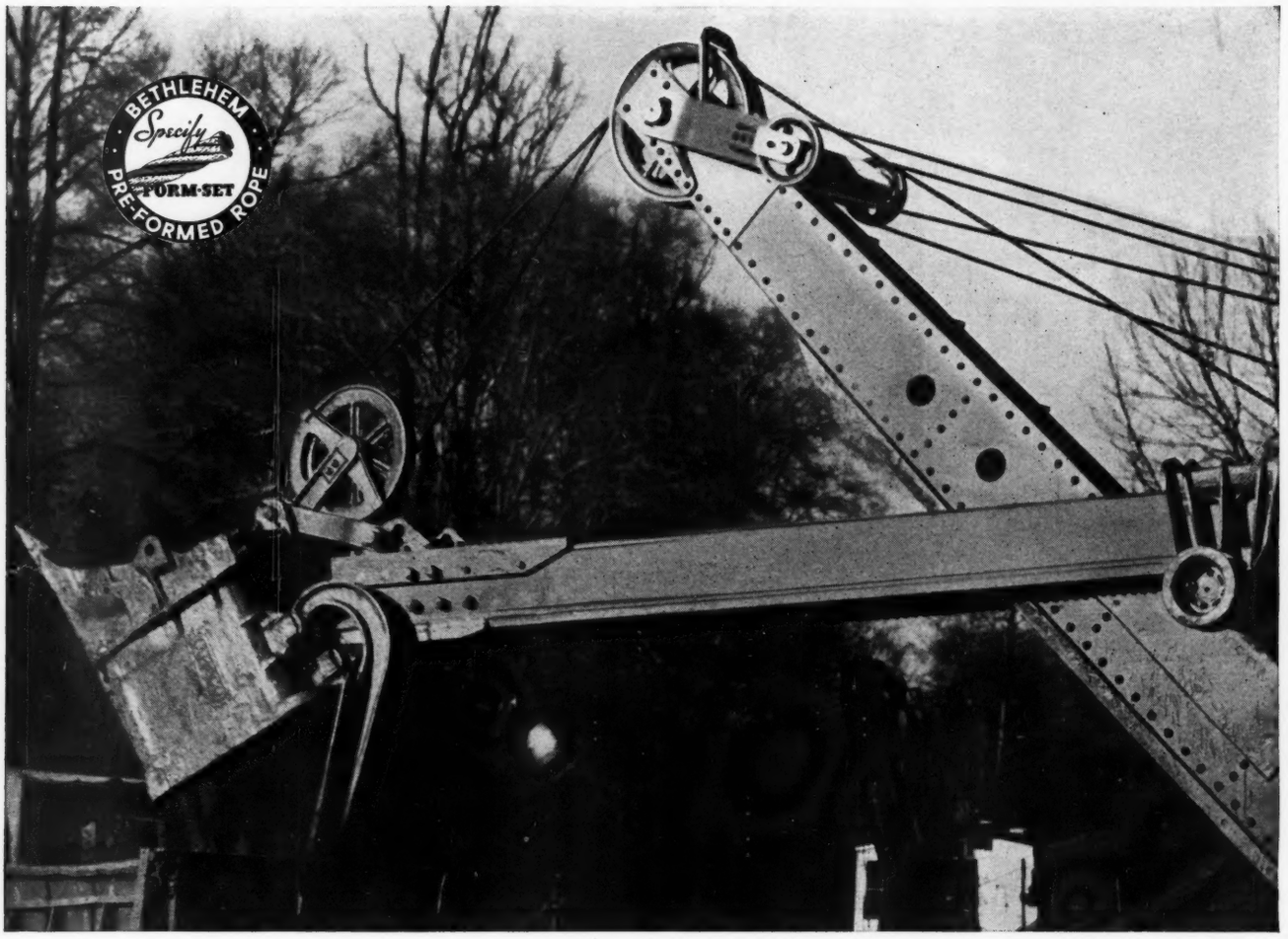
PLUGS—Square Head, Solid, Countersunk, Bar, Barrel



NIPPLES—Close, Short, Long, Tank

UNIONS—Ground Ja... Gasket Type, Female, M... and Female, Air-Pump

A CRANE FITTING FOR EVERY PURPOSE—The screwed fittings shown above are only a few of the scores of different types and sizes of Crane screwed fittings. This line includes banded and plain patterns, black or galvanized, in a wide range of straight and reducing sizes, in four



Over sheaves with less fatigue

FORM-SET PURPLE STRAND

HERE'S the spot that wears out rope on many types of jobs. The individual wires are pulled, bent and twisted in the one operation of running over a sheave under load. The smaller the sheave, the greater the strain. And a reverse bend over small sheaves writes a quick death sentence to ordinary line. Sheaves, even small sheaves, can't always be eliminated. But wire rope can be made which will give greater life when this bending fatigue is severe. In Purple-Strand Form-Set lines it is done by pre-forming the strands—so shaping them that damaging internal stresses are minimized, leaving individual strands and wires free to use their full strength for external work. There is less whipping, less tendency to kink. The rope is easier to handle; it spools better. Above all, it has greater resistance to fatigue.

Combine this fatigue resistance of Form-Set construction with the strength and toughness of Purple-Strand quality—and you have a real line. For Purple Strand is top quality in rope; it measures up to strength standards of Improved Plow Steel in every way; it has even higher fatigue strength than standard IPS. Purple-Strand wire is made only from premium-priced steel made in Bethlehem's own plants and drawn in a mill making only rope wire—under the supervision of the same metallurgical staff responsible for the performance of the finished rope.

BETHLEHEM STEEL COMPANY, *General Offices:* Bethlehem, Pa. *District Offices:* Albany, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Detroit, Honolulu, Houston, Indianapolis, Johnstown, Pa., Kansas City, Mo., Los Angeles, Louisville, Milwaukee, Nashville, New Haven, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, Salt Lake City, San Antonio, San Francisco, Savannah, Seattle, Syracuse, Toledo, Tulsa, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

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SHAFT HOIST ROPES

LOADING SHOVEL

– PRE-FORMED ROPES SAVE MONEY

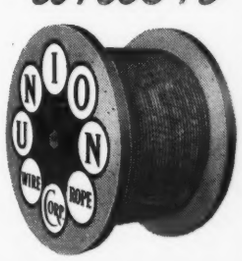
Because pre-formed rope has a slightly higher first cost, many mine operators have never thought of it as a money-saver! Yet the fact is that in many mining services pre-formed costs substantially less, in the long run, than ordinary fabrication.

This is because pre-formed rope, being free from internal stresses, is much slower to fatigue under the combined stresses of constant bending; and because it better withstands abrasion, as worn wires will not arch in the strand, and broken wires will not stick out, causing injuries to workmen. In service where bending or abrasion is severe, pre-formed will far outlast ordinary rope and effect a substantial money saving.

"UNION-formed" Rope (our superior pre-formed product) should be used for Shaft Hoist Ropes; for Hoist Ropes on digging and loading shovels, draglines, cranes and derricks; for all Mining Machine Lines; for Scraper Loader Lines, Conveyor Ropes, Slusher and Mucker Lines, Haulage Ropes, Car Pullers—in short, wherever ropes are subjected to severe bending or abrasion.

"UNION-formed" Rope offers you an opportunity to definitely reduce your rope expense. Secure the recommendations of our nearest distributor.

Union FORMED



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1938
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Is THIS in the public welfare? If you have a superior product at a fair price it decidedly is!

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Dramatic, skillful and *consistent* advertising is doing it for many and can do it for you, simply by educating more and more people to recognize the many benefits of buying your product — now.

Ask your advertising agency whether your appropriation is adequate to accomplish this objective of increasing your share of the business — now.

Published in the interests of greater sales, employment and profits in 1938 by the
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TIMKEN BITS

GIVE YOU REMOVABLE ROCK BIT BENEFITS IN *Full*

The factors responsible for the superior performance and longer life of the TIMKEN Rock Bit are design and material.

First of all there is the *shoulder construction* by means of which the drill blows are transmitted uniformly to the cutting edges of the bit, thereby producing faster penetration.

This type of construction also makes possible the streamlining of the bit and steel. Streamlining means easier withdrawal after drilling as there are no obstructions for chips to lodge behind and plug the bit in the hole.

TIMKEN Bearings are used on all locomotives and many of the cars of the new 20TH CENTURY LIMITED

TIMKEN Electric Furnace Steel manufactured in our own steel mill assures bits of maximum hardness and strength. It gives TIMKEN Bits greater resistance to abrasion and thus enables them to drill more footage.

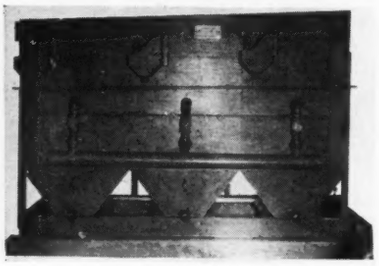
When you decide to adopt removable rock bits—as you will sooner or later—be sure to select the bits that will give you removable bit benefits in full—TIMKEN Bits.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; TIMKEN Rock Bits; and TIMKEN Fuel Injection Equipment.

TIMKEN
ROCK BITS

BENDELARI DIAPHRAGM JIGS



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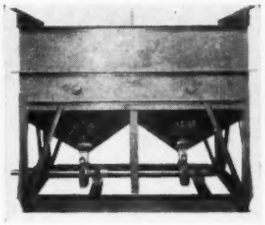

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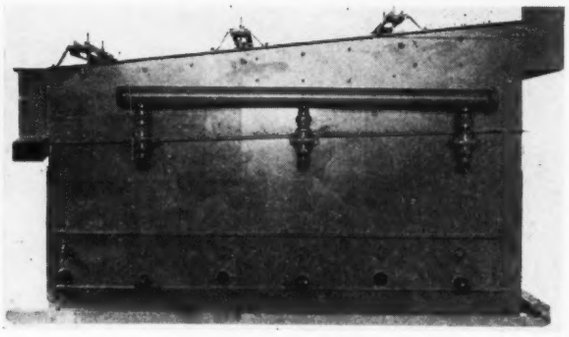
California type



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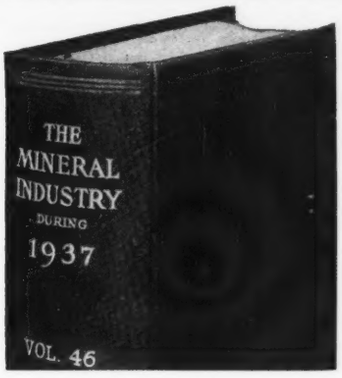

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This year MINERAL INDUSTRY is of particular interest for its Review, by the editor, G. A. Roush, of progress in mineral production during the 25 years of his editorship (1913–1938). This review covers world production of the leading products, giving a representative cross-section of the world's mineral industry during the period. In addition, there is presented a series of world index charts of production of each of the leading products, and a combined world total index.

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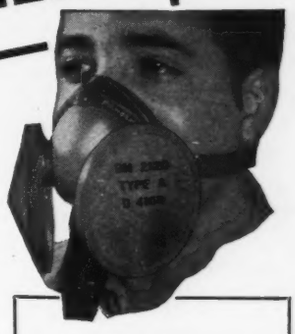

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Bell Telephone Laboratories developed this new *voice-powered* telephone especially for portable use. Transmitter, receiver and signaling device are in *one unit* measuring 3" x 3" x 2½", weighing only 1 lb. 14 oz.

It needs no batteries or other external power—can be connected to the line in a few seconds. It's sturdy, dependable, transmits clearly over many miles.

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Gentlemen: Please send me bulletin describing the new Western Electric 10A Voice-Powered Telephone. EMJ 12-38

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1913 - SERVING INDUSTRY - 1938
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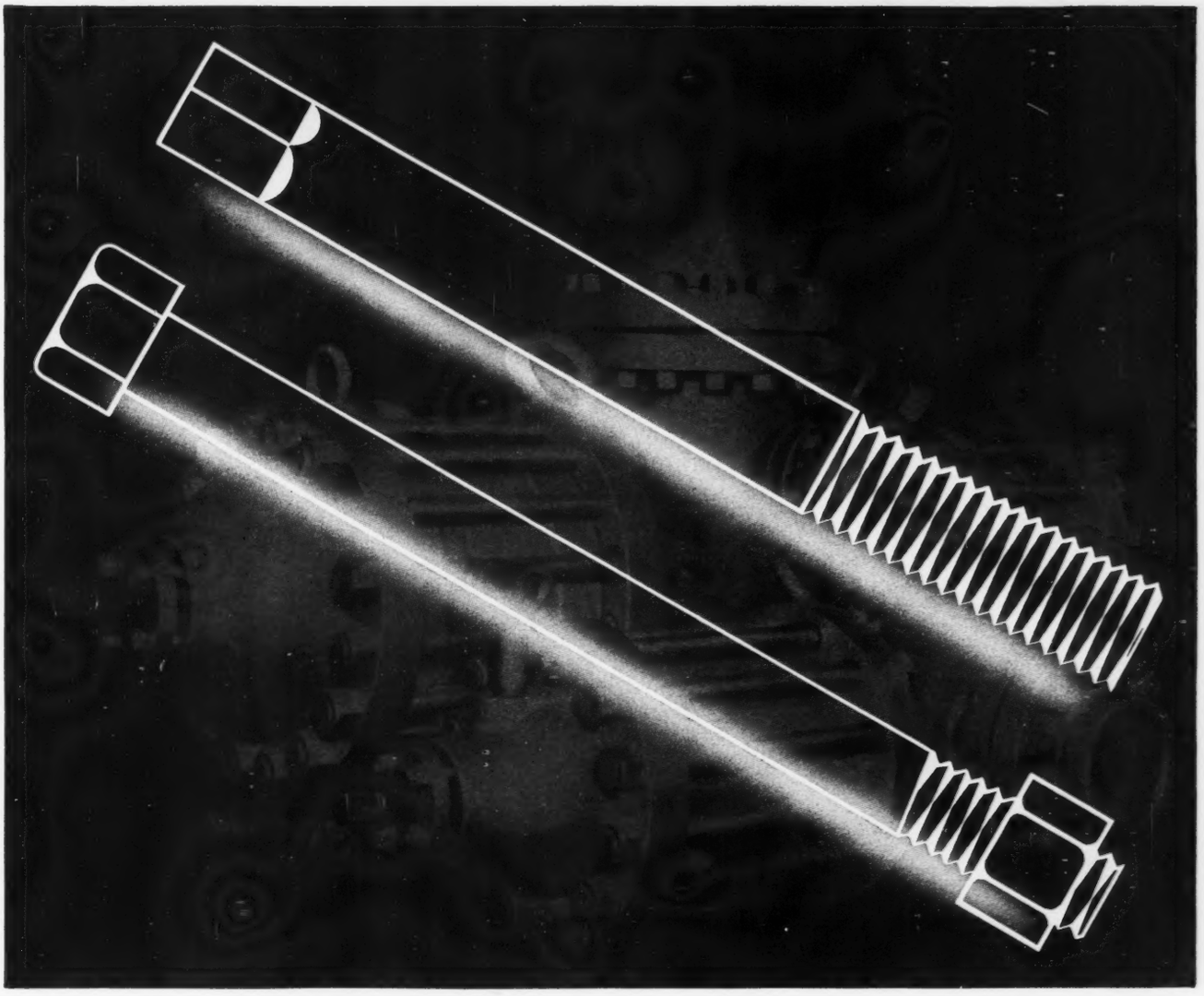
*Reg. U. S. Pat. Off. by Hercules Powder Company PP-25



WHERE HIGH PRESSURE MUST BE CONTROLLED

When oil drilling encounters pressures of several thousand pounds per square inch, there must be no "ifs" or "buts" about the blow-out preventer's capacity to hold things in check. In one particular type of blow-out preventer (6000-pound test), thrust screw and head bolts play a vital part in preventing accidents and waste. They are made of Chrome-Moly (S.A.E. 4140) steel because:

(a) Chrome-Moly bolt stock can be heat treated in tonnage lots with perfect assurance of consistently developing the combined strength and toughness to withstand heavy loads and to prevent threads from stripping.

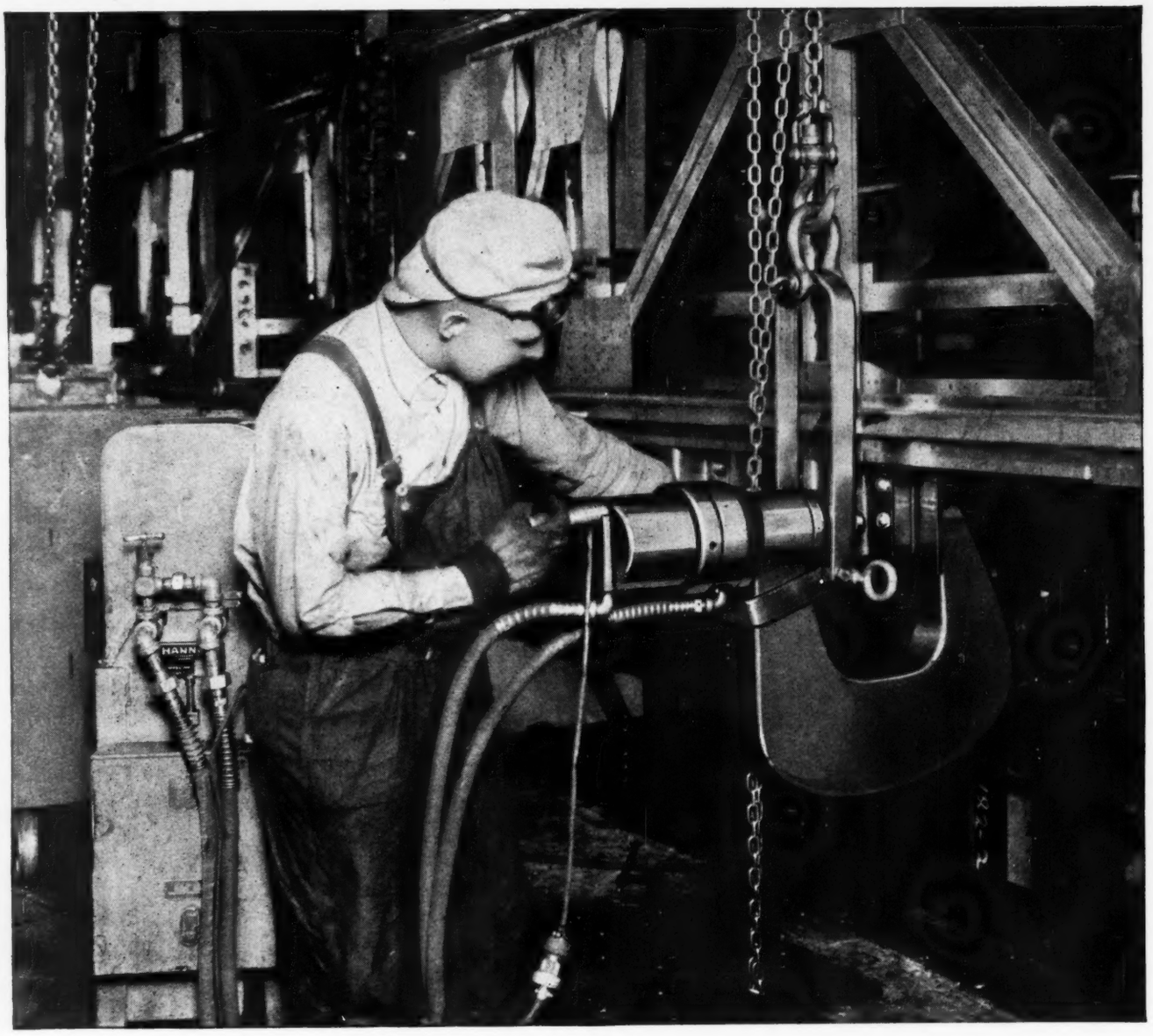
(b) Chrome-Moly bolts are readily machinable after heat treating.

Bolt and parts manufacturers seeking to speed up and simplify production, reduce costs, and still give their customers a better product, should send for our free book, ***"Molybdenum in Steel."*** Climax Molybdenum Company, 500 Fifth Avenue, New York.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

Climax Mo-lyb-den-um Company

MOLY



50-Ton Squeeze · · · Rubber to Steel

A typical example of Goodrich improvement in rubber

RIVETING usually means hammering — but not always. A powerful hydraulic machine now squeezes a cold steel rivet into place with a 50-ton pressure — and does it in three seconds, with little noise and no red-hot rivets flying through the air.

A manufacturer developed this machine but to make it practical for many jobs such as car bodies and frames, it had to be portable. That meant flexible hose from the source of pressure to the riveter. But a 50-ton squeeze needed thousands of pounds of pressure in the hose and to make it worse, the pressure is a sudden load. No flexible hose built could stand such loads without bursting.

Goodrich engineers had been working on high-pressure hose for automobile hydraulic brakes and other uses. They had found a way to braid a fifth of a mile of high-tensile steel wire into every foot of hose. With this as a starting point, Goodrich engineers went to work, still further improved the strength of their hose by improved rubber compounds, and finally developed a hose with the unheard-of burst strength of 20,000 pounds per square inch.

This is the sort of research in which 150 Goodrich engineers are constantly engaged—which has produced transmission belts flexing five times as long as former belts, conveyor belts which stand severe use many times as long, rubber for numerous products which resists ageing, chemicals, heat, abrasion. These improvements can save money in your plant as they are saving for thousands of others. They are automatically yours when you specify *Goodrich* to your distributor. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

(*Another story of Goodrich Development appears on page* 4)

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WHAT BEARING SHOULD I SPECIFY FOR MY MINING EQUIPMENT ?

[THE FIRST OF A SERIES OF QUESTIONS TO HELP SOLVE THE BEARING PROBLEMS OF MINE OPERATORS]

Before selecting the make of bearing to be used in your equipment, don't you owe it to yourself to get answers to these questions from any bearing manufacturer whose product you are considering? The answers as applying to the TIMKEN Tapered Roller Bearing are included below.

How long has your company been making bearings?

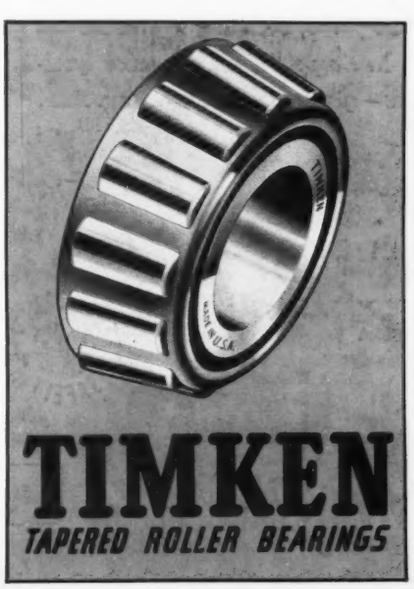
The Timken Company has specialized in tapered roller bearings for over 40 years.

Who owns the bearing company?

The Timken Company is a large all-American corporation, having over 20,000 shareholders.

How long have actual sales of bearings been made for mining equipment?

The Timken Company pioneered in engineering tapered roller bearings in all kinds of mining equipment and has been supplying bearings in volume for 18 years.



Where is the bearing used as standard equipment in mining machinery?

Practically every leading maker of mine cars, conveyors, loaders and other equipment uses TIMKEN Bearings—if not exclusively, at least predominantly.

How many of the bearings have given satisfactory service in mine cars for instance?

Over 2,400,000 TIMKEN Bearings have been applied to mine cars alone.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

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THE A B C's of WIRE ROPE

When a piece of unseized wire rope can rest so contentedly as this LAY-SET Green Strand, you *know* it is a relaxed rope—free of internal stress. And being relaxed—being preformed—it is a limber, flexible rope. Easy to handle, easy to splice, fast to reeve. Being preformed, LAY-SET resists kinking and whipping; almost refuses to rotate in sheave grooves; spools perfectly. More than this, LAY-SET Preformed is a safe rope to handle because when the crown wires are finally worn through they lie flat and in place, refusing to wicker out and tear workmen's hands. Naturally, having all these superior qualities, LAY-SET Preformed lasts longer—gives greater dollar value.

Send today for a free copy of "Safe Use of Wire Rope." It is so constructive you will want every machine operator to read it.

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Established 1846
AMERICAN CHAIN & CABLE COMPANY, Inc.
WILKES-BARRE, PENNSYLVANIA
District Offices: New York, Chicago, Philadelphia, Pittsburgh, Fort Worth, San Francisco, Denver, Los Angeles, Atlanta, Tacoma

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Weed Tire Chains • Welded and Weldless Chain • Malleable Castings
Acco-Morrow Lubricators

ANDREW C. CAMPBELL DIVISION
Abrasive Cutting Machines • Floformers
Special Machinery • Nibbling Machines

FORD CHAIN BLOCK DIVISION
Chain Hoists • Trolleys

HAZARD WIRE ROPE DIVISION
Lay-Set Preformed Wire Rope • "Korodless" Wire Rope • Preformed Spring-Lay Wire Rope • Guard Rail Cable

HIGHLAND IRON & STEEL DIVISION
Wrought Iron Bars and Shapes

MANLEY MANUFACTURING DIVISION
Automotive Service Station Equipment

OWEN SILENT SPRING COMPANY, Inc.
Owen Cushion and Mattress Spring Centers

PAGE STEEL AND WIRE DIVISION
Page Fence • Wire and Rod Products
Traffic Tape • Welding Wire

READING-PRATT & CADY DIVISION
Valves • Electric Steel Fittings

READING STEEL CASTING DIVISION
Electric Steel Castings, Rough or Machined Railroad Specialties

WRIGHT MANUFACTURING DIVISION
Chain Hoists • Electric Hoists and Cranes

In Business for Your Safety

LAY-SET *Preformed* WIRE ROPE

ALL HAZARD WIRE ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE GREEN STRAND